

**EPA Superfund
Record of Decision:**

**ABERDEEN PESTICIDE DUMPS
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10/07/1993**

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July 1994

EPA Superfund

Record of Decision:

Aberdeen Pesticide Dumps

Site, Aberdeen, NC

<Figure>

ABERDEEN PESTICIDE DUMPS SITE

ABERDEEN, MOORE COUNTY, NORTH CAROLINA

RECORD OF DECISION

OPERABLE UNIT THREE

**FARM CHEMICALS, TWIN SITES, FAIRWAY SIX
AREAS**

REGION IV

ATLANTA, GEORGIA

OCTOBER 1993

**DECLARATION FOR THE
RECORD OF DECISION**

SITE NAME AND LOCATION

Aberdeen Pesticide Dumps Site
Aberdeen, Moore County, North Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Operable Unit Three (OU3) of the Aberdeen Pesticide Dumps Site (the "Site"), in Aberdeen, North Carolina, which was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). OU3 addresses contamination in groundwater, sediment and surface water and ecological considerations at the three Areas of the Site, known as Farm Chemicals, Twin Sites and Fairway Six. This decision is based upon the contents of the Administrative Record for OU3 of the Site.

The State of North Carolina concurs in this decision.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The remedy selected addresses groundwater, sediment, and surface water contamination and ecological concerns to eliminate or reduce the risks posed by the Site. The major components of the selected remedy for the Farm Chemicals/Twin Sites Areas include:

- Extraction of groundwater across OU3 that is contaminated above performance standards utilizing extraction wells, and/or interceptor trenches;
- Pretreatment consisting of equalization and neutralization;
- Inorganic contaminant removal consisting of coagulation/flocculation/precipitation, sludge separation, dewatering and off-site disposal;
- Organic contaminant removal utilizing air stripping followed with incineration of off-gases followed by acid gas scrubbing;
- Post treatment consisting of Granular Activated Carbon (GAC) adsorption of the liquid-phase with off-site regeneration of spent GAC;
- Discharge of treated water by infiltration basin, injection wells, discharge to Publicly Owned Treatment Works (POTW) or discharge to Aberdeen Creek; and
- Continued monitoring of the environment affected by the sediment and surface water contamination; and

The major components of the selected remedy for the Fairway Six Area include:

- Extraction of groundwater across OU3 that is contaminated above performance standards utilizing extraction wells and/or interceptor trenches;
- Pretreatment consisting of equalization and neutralization, as appropriate;

- Organic removal consisting of Granular Activated Carbon (GAC) adsorption of the liquid-phase with off-site regeneration of spent GAC;
- Discharge of treated water by infiltration basin, injection wells, discharge to Publicly Owned Treatment Works (POTW) or discharge to Aberdeen Creek; and
- Continued monitoring of the environment affected by the sediment and surface water contamination.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and are cost-effective. The selected remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and satisfies the statutory preference to reduce toxicity, mobility, or volume as a principal element. Because this remedy may result in hazardous substances remaining on the Site, the five-year statutory facility review will apply to this action.

October 7, 1993

Date

Patrick M. Tobin
Acting Regional Administrator

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DECISION SUMMARY

1.0 SITE NAME, LOCATION AND DESCRIPTION

1.1 Introduction

The Aberdeen Pesticide Dumps Site (the "Site"), consisting of five distinct Areas, is located near the town of Aberdeen, Moore County, North Carolina (Figure 1). The five Areas are Farm Chemicals, Twin Sites, Fairway Six, McIver Dump and Route 211. This Record of Decision, described as Operable Unit Three (OU3), addresses contamination at the Farm Chemicals, Twin Sites and Fairway Six Areas. The media to be addressed in this document include groundwater, sediment, and surface water. In addition ecological concerns are addressed. Figure 1 shows the location of each Area and the Town of Aberdeen. The location and description of each Area are summarized below.

1.2 Site Description

The Farm Chemicals Area is located on the south side of North Carolina Highway 5 (Pinehurst Road) about 0.5 miles west of the intersection with U.S. Highway 1. The Area is on the western corporate limit of the Town of Aberdeen (Figure 2). Coordinates are: latitude 35 08'24"N; longitude 79 25'58".

The Farm Chemicals Area is situated on flat terrain. However, downgradient of the Area and at a distance of approximately 500-700 feet is Pages Lake, which is used for swimming, fishing, and general recreation use. It is a man-made body that is fed by Aberdeen Creek, which flows to the south.

The land to the south and west of the Farm Chemicals Area is occupied by commercial or light industrial properties. Residential property bounds the Area to the east. The nearest residents live approximately 250 feet from the Area. North of the Area is Highway 5 and directly across Highway 5 is the Twin Sites Area. The Farm Chemicals Area accommodates an abandoned chemical blending facility which consisted of approximately 19 structures. Figure 2 shows that the site layout and Figure 2a is a key identifying the structures. As noted on the legend, some of the buildings have been removed. Farm Chemicals, Inc., abandoned the facility in 1987. The existing property boundaries are fenced.

The Twin Sites Area is located north of Highway 5, at the western corporate limit of the Town of Aberdeen, and west of Pages Lake. Coordinates of the Area are: latitude 35 08'24"N; longitude 79 25'58"W.

The Twin Sites Area consist of three disposal areas (Figure 3). Areas A and B were both open dumps within wooded areas. Area A is approximately 400 ft. x 250 ft. and Area B is approximately 235 ft. x 120 ft. These two areas lie approximately 350 ft. from one another. Area C is a small patch of woods in between Areas A and B. The dimensions of Area C are unknown, because most of the pesticide-like materials are buried.

<Figure>

FIGURE 1 ABERDEEN PESTICIDE DUMPS SITE LOCATION MAP

<Figure>

FIGURE 2 SITE LAYOUT FARM CHEMICALS AREA

<Figure>

<Figure>

FIGURE 3 SITE LAYOUT - TWIN SITES AREA

The Twin Sites Area is situated on moderately sloping terrain (5%), which slopes in a N-NE direction toward Pages Lake, about 350 feet downgradient from the disposal areas. Groundwater seeps and standing water pools are located in a wet area between the disposal areas and Pages Lake. Aquatic plants are found in this wet area.

The Twin Sites Area is bounded on the east by woods, on the north by Pages Lake, on the south by Highway 5, and on the west by the corporate limits of the Town of Aberdeen. The nearest residents live about 350 feet upgradient from disposal Area B. More than 1,000 people live within a one-mile radius. A former Jaycees Hut and a Boy Scout Camp are located 350 feet downgradient of the Area. The Jaycees Hut was unused between 1985 and 1990. Currently, the facility operates as a day center by a drug rehabilitation group. The Boy Scout Camp is not used for camping; however, it is used once a week for meetings. There is a newly constructed beach area directly downgradient of the Boy Scout Camp on the western shore of Pages Lake.

The Fairway Six Area is situated off NC Highway 5 west at the "Pits Golf Links" golf course, approximately 1.6 miles west-northwest of the Aberdeen corporate limits. Coordinates of the Area are latitude 35 08'50"N; longitude 79 27'27"W. The Area is rural and sparsely populated.

The Fairway Six Area consists of a cleared area utilized for a test burn of pesticide contaminated soil in December 1986; an area of surface contamination (approximately 345 ft. x 225 ft.) on the south and north of Fairway No. 6, immediately adjacent to the tee area; and six excavated trenches and associated stockpiled soils (Figure 4).

The Fairway Six Area is situated on gently sloping terrain which drains to the northeast towards the golf course lake. Two swales drain surface water from the area known contamination. Due to prior removal action at this Area, surface runoff from the immediate area drains into the existing trenches.

The Pits Golf Links golf course forms the northern boundary of the Area. To the east and west lies wooded property that is privately owned, and was once planned for residential development (EPA 1991).

<Figure>

FIGURE 4 SITE LAYOUT FAIRWAY SIX AREA

1.3 Demography and Land Use

According to the 1980 Census, the population of Aberdeen was about 2,000. However, information obtained from the Town of Aberdeen indicated that the population in 1988 was about 2,735. The estimated population within a 1-mile distance of each Area is:

Farm Chemicals	>1,000
Twin Sites	>1,000
Fairway Six	<1,000

The Aberdeen area is primarily residential with some light industry. The Twin Sites and Fairway Six Areas are zoned residential, while the Farm Chemicals Area is zoned commercial/residential. There are no endangered species or critical habitats, national parks, national wildlife refuges or Indian reservations in the vicinity of Aberdeen.

The primary recreation in the area is golf. Within a 10-mile radius of Aberdeen there are 36 championship golf courses. A large seasonal influx of visitors to the numerous golf courses in the area occurs in the spring and the fall. Most of these visitors are elderly and stay for a week or two at a time. Pages Lake is used as a recreational facility by the Town of Aberdeen for fishing and swimming. A former Jaycees Hut and a Boy Scout Camp are located on the edge of the lake, downgradient from the Farm Chemicals and Twin Sites Areas. The Jaycees Hut was unused between 1985 and 1990. Currently, the facility operates as a day center by a drug rehabilitation group. The Boy Scout Camp is not used for camping; however, it is used once a week for meetings.

1.4 Soil

Soils in the vicinity of the OU3 belong to the Candor Series. These soils include well- to very well-drained sandy surface soils, and sandy to sandy clay loam soils of the Coastal Plain Uplands. These sandy soils have excellent permeability and are not expected to retard the

infiltration of materials to the subsurface.

1.5 Regional Geology

All of the Areas are located in the "Sand Hills" region of the Atlantic Coastal Plain Province. This region is characterized by rolling hills with 200 to 300 feet of topographic relief. Four formations underlie the study area in the following descending order and dip six to eight feet per mile to the southeast:

- (1) the Pinehurst Formation, surficial sediments which cap the hills of Aberdeen consist of poorly sorted, unconsolidated sands and gravels.
- (2) the Middendorf Formation, consists of unconsolidated sands and silty sands with lenses of kaolinitic clay, sandy clay, and gravel. The base consists of an unconsolidated gravel which does not exceed 6 feet in thickness and is absent in places.
- (3) the Cape Fear Formation, the basal sedimentary unit overlying the Carolina Slate Belt is estimated to be 25 to 115 feet thick and consists of carbonaceous clays.
- (4) the Carolina Slate Belt, the crystalline "basement" is composed of fine-grained metamorphic rocks.

1.6 Site-Specific Geology

Two of the four formations were encountered in monitoring wells installed as part of the field investigation conducted from 1989 through 1991. All of the wells encountered the Middendorf Formation, which is the surficial formation in the Aberdeen area. The Middendorf Formation contains the Black Creek Aquifer, which consists of undifferentiated sands, silty sands, clayey sands, gravels, and clays. Clay lenses were common and were generally a few inches to a few feet thick. The areal extent of any clay lens was very limited and generally could not be correlated between the wells at an Area. One exception is a clay layer, which extends under most of the Fairway Six Area and varies in thickness from 3 to 20 feet.

All of the wells installed at the Farm Chemicals and Twin Sites Areas encountered the base of the Middendorf Formation. In the Farm Chemicals/Twin Sites Areas, the base of the Middendorf Formation consists of a clean, medium to coarse grained sand with a few pebbles to a coarse gravelly sand to gravel.

The base of the Middendorf Formation was also encountered in the deep well (3-MW-05) at the Fairway Six Area, the regional monitoring well (6-MW-01) and several of the regional piezometric wells installed.

The top of the Cape Fear Formation was encountered in 18 monitoring wells that penetrated the base of the Middendorf Formation. Except for monitoring well 3-MW-05, all of the wells penetrated only a few feet into this formation. The Cape Fear Formation generally varied from a clay to sandy clay with rare lenses of clean, medium to coarse sand.

1.7 Hydrogeology

There are three regional hydrostratigraphic units that underlie OU3. They are the Sand Hills Aquifer, the Cape Fear confining zone, and the crystalline rock of the Carolina Slate Belt. The primary aquifer in the Aberdeen vicinity is the Sand Hills aquifer, which is comprised of both the Middendorf and, where present, the overlying Pinehurst Formations. The clay-rich Cape Fear Formation acts as an "aquitard" and separates the overlying aquifer from the crystalline rock aquifer. Figure 5 illustrates the geologic and hydraulic units (Source: U.S. Geological Survey "Hydrogeology and Simulation of Ground-Water Flow in Aquifers at the Aberdeen Superfund Sites, NC," February 1993).

<Figure>

Figure 5 -- Relations of geologic and hydraulic units.

(Source: U.S. Geological Survey, "Hydrogeology and Simulation of Ground-Water Flow in Aquifers at the Aberdeen Superfund Sites, NC," Feb. 1993)

The Sand Hills aquifer consists of a system of ridges separated by stream valleys which generally are incised into the underlying aquitard. The thickness of the aquifer varies from a few feet in the stream valleys to 300 feet at the crest of the higher ridges. Recharge of the groundwater reservoir is almost entirely by direct precipitation. The unconsolidated sands and gravels of the Pinehurst Formation allow rapid infiltration of precipitation to the water table. Figure 6 illustrates a cross-section in the Aberdeen area (Source: U.S. Geological Survey "Hydrogeology and Simulation of Ground-Water Flow in Aquifers at the Aberdeen Superfund Site, NC," February 1993). Table 1 identifies the hydrogeological conditions at the Farm Chemicals, Twin Sites and Fairway Six Areas.

1.8 Climate

Aberdeen is in the Humid Subtropical Zone which prevails through the Southeast. This Zone is characterized by long, hot, humid summers and relatively mild winters. The average daily mean temperature is approximately 60 F, with average daily minimum temperatures varying 10 F from the mean. The average daily maximum temperature during the summer months is 85 F. The relative humidity is 85% in the mornings and drops to 54% in the afternoon. The area receives approximately 47-50 inches of precipitation per year, most of which occurs in the spring and summer. The mean annual prevailing wind is from the southwest at approximately 9 miles per hour.

1.9 Surface Drainage

The three Areas are in the Aberdeen Creek drainage basin (Figure 7). Aberdeen Creek is a north - south flowing tributary to Drowning Creek with a drainage area of approximately 38 square miles and an average discharge of 51 cubic feet per second. Surface water bodies in the Aberdeen area are classified as follows:

- Aberdeen Creek between the dam at Watson's Lake and the backwaters of Pages Lake, Class WS-III (human water supply source)
- Pages Lake, Class B (recreational use), and
- Aberdeen Creek from the dam at Pages Lake to Drowning Creek, Class C (typical fresh surface water)

The amount of surface runoff reaching the creeks in the area is limited by the highly permeable soil. Only about 15% of the precipitation reaches the creeks by overland flow and 23% of it reaches the creeks by groundwater runoff. The bulk of the precipitation (62%) is either lost as evapotranspiration or enters the groundwater. Short duration intense thunderstorms are common to this area resulting in surface runoff which may erode and transport contaminated soil.

<Figure>

Figure 6.--Hydrogeologic section B-B' through Aberdeen, North Carolina.

(Source: U.S. Geological Survey, "Hydrogeology and Simulation of Ground Water Flow in Aquifers at the Aberdeen Superfund Sites, NC," Feb. 1993)

<Figure>

<Figure>

FIGURE 7 Aberdeen Creek Drainage Basin Aberdeen, North Carolina

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

Farm Chemicals Area

From at least the mid-1930s through 1987, three successive companies blended or formulated millions of pounds of pesticides at the formulation plant located on the Farm Chemicals Area. Those companies were Taylor Chemical Company (mid-1930s until 1964), Grower Service Corporation (1964-71), and Farm Chemicals, Inc. (1972-87). Those companies reformulated, or blended, or diluted technical grade pesticides (generally pure or nearly pure pesticides) into commercial grade, finished pesticide products for agricultural use. Those companies formulated finished, commercial grade pesticides as their own products under their own labels (such as "Superkill" for Taylor Chemical).

Taylor Chemical, Grower Service and Farm Chemicals also formulated finished, commercial grade pesticide products for other companies. It was and is common practice in the pesticide industry, for manufacturers of technical grade pesticides to contract with pesticide manufacturers for the formulation of finished, commercial grade pesticides. Such practice may be taken for various business reasons, including transportation and production cost. The companies for whom Taylor Chemical, Grower Service or Farm Chemicals formulated finished pesticide products would furnish and retain ownership of the technical grade pesticides throughout the formulation and packaging process.

Taylor Chemical Company was one of the largest formulators in the Southeast during its operation. Taylor Chemical formulated cotton dust and other products for DuPont, Olin-Mathieson (a predecessor of Olin Corp.), Columbia Southern or Columbia Chemicals (a predecessor of PPG Industries), and Howerton Gowan Chemical Co. (a predecessor of UCI Holdings, Inc.). Taylor Chemical was liquidated and dissolved after it ceased its formulation operations in 1964.

Grower Service was a subsidiary of Union Carbide Corporation during the time (1964-72) that it owned and operated the formulation plant located on the Farm Chemicals Area. Grower Service formulated millions of pounds of finished "Sevin" products for Union Carbide. Additionally, Grower Service formulated for Mobil Oil Corp., the Kaiser Agricultural Division of Kaiser Aluminum and Chemical Corp., and Chemagro Corp. (a predecessor of Miles Inc.). Grower Service continued without substantial operational change to the pesticide formulation operations of Taylor Chemical. Grower Service continued to formulate commercial grade pesticides in liquid, dust and granular form.

In 1972, Farm Chemicals bought the formulation plant from Grower Service: Farm Chemicals continued to formulate liquid pesticides, but stopped blending pesticide dusts and powders. Farm Chemicals formulated finished pesticide products for Shell, and Boots-Hercules Agrochemicals Company (a joint venture between Hercules, Inc. and the Boots Company (USA), Inc.) and/or BFC (a predecessor of NOR-AM). In 1987, Farm Chemicals entirely stopped its pesticide-blending operations at the Aberdeen plant and abandoned that facility.

Pesticides in technical grade strength are not usable for agricultural use by farmers without formulation or blending into a diluted form. The pesticide formulation or blending process generates a large quantity of wastes containing pesticides, including bags and drums containing residues of technical grade pesticides, and also results in spills and releases of pesticides into the air and soils. Extremely high levels of pesticide contamination have been confirmed around the formulation buildings and loading docks of those formulation buildings and warehouses. The generation, disposal and release of wastes containing pesticides and pesticide constituents through spills, discharges, cleaning of formulating and storage buildings and equipment, blending and formulation operations and processes (such as mixing and grinding), production of batches that do not meet specifications, packaging, loading, unloading and movement of technical grade and commercial pesticides, disposal of used technical grade pesticide bags, drums and other containers, cleaning of used metal technical grade pesticide drums, and other means was inherent in and incident to the pesticide formulation and packaging process conducted at the Farm Chemicals Area by Taylor Chemical, Grower Service and Farm Chemicals.

The three formulator companies received technical grade pesticides in powder, liquid or solid form from the pesticide manufacturers, and then blended or formulated those technical grade pesticides into commercial grade pesticide products in liquid, powder, dust and/or granule form. For liquid commercial products, the formulators mixed the technical grade pesticide in a large

vat with solvents and emulsifiers. For powder or dust commercial products, the formulators mixed the technical grade pesticide with inert fillers (such as clay) in large mixers similar to concrete mixers. For granular commercial products, the formulators applied the technical grade pesticides in liquid form to granules in mixers.

During and as an integral part of their pesticide formulation operations on the Farm Chemicals Area, Taylor Chemical, Grower Service and Farm Chemicals buried, disposed of or spilled substantial quantities of wastes containing liquid and dust pesticides at that Area. Those buried wastes included empty technical grade bags and containers, spill cleanup materials, and broken bags of finished pesticide products. Several pesticide waste disposal holes are located in that Area. In addition, releases of pesticides onto the ground occurred during the steam cleaning of metal drums that had contained technical grade pesticides. The metal drums were steam-cleaned directly over the ground within the plant area.

The pesticide formulation process itself also unavoidably resulted in spills and other releases of both technical grade and finished pesticides. Spills and releases of pesticides occurred during loading, unloading and intra-plant transport of both technical grade and finished pesticides, as bags and other containers were inadvertently torn or opened so that pesticides were released onto the ground. Spills and releases also occurred during the formulation process itself. The dust or powder blending process required cutting or tearing open bags of technical grade pesticides, dumping the pesticides along with inert carriers (such as clay) into a mixer, and bagging the blended finished product. Further spills occurred during cleanup of buildings and equipment.

Spills and releases also occurred during the liquid formulation process. Technical grade pesticides and appropriate other ingredients (including solvents, some of which, such as xylene, were themselves hazardous substances) were blended in large mixing vats. Spills and releases occurred during the blending process. The concrete floor of the open-sided liquid formulation building was covered with pesticides during periods of formulation. Those pesticides frequently spilled over onto the ground. In addition, pesticides were spilled or released onto the ground during cleaning of the liquid formulation equipment. The liquid building and its blending vat were regularly cleaned with xylenes, which are hazardous substances. The resulting mixture of pesticides and xylenes either ran off onto the ground or was placed into a disposal pit on the Farm Chemicals Area.

In October 1987, during the site reconnaissance conducted by EPA's remedial contractor, the REM V Team, sulfur and possibly pesticide-like odors were noticed on site. Crystallized finger-shaped substances (presumed to be pesticide) with yellowish or black tips were found on-site. The chemicals or materials were similar to those identified at the Twin Sites Area across the street from the Farm Chemicals Area.

Between May 11-16, 1986, high frequency ground penetrating radar (GPR), terrain conductivity, and magnetic field surveys were conducted on the southern portion of the plant. The GPR profiles indicated the presence of an extensive trench system underlying the southern portion of the Farm Chemicals' property. Low terrain conductivity measurements over the trench area suggested non-conductive trench contents, i.e., paper, plastic, and drums. Augering confirmed the nature of the trench contents and subsequent analysis of subsurface material revealed contamination by several pesticides and polychlorinated biphenyls (PCBs). Scattered spots of magnetic field anomalies were also detected, possibly indicating the presence of buried metallic objects (EPA-TAT, July 1986).

The GPR survey was extended onto the Brooks-Perkins property south of and immediately behind Farm Chemicals' property. This survey identified a possible trench like structure along with several buried drum-like objects. Terrain conductivity and magnetic field surveys were not conducted to verify the GPR findings due to time constraints. It was recommended at the conclusion of the GPR survey that additional data be collected to verify the findings (EPA-TAT, July 1986).

Four soils samples from the southern part of the Farm Chemicals' property and the adjacent Brooks-Perkins property were collected and analyzed. A soil sample collected at a depth of 7

feet on the Farm Chemicals' property confirmed the presence of a buried trench with contamination levels of 800 parts per million (ppm) 4,4'-DDT and 100 ppm PCBs.

Twin Sites Area

Taylor Chemical used the Twin Sites Area for disposal of dusts, wastes, bags and other used pesticide containers from 1945 through 1949. During those years, Taylor Chemical formulated pesticide dusts for itself, as well as Olin-Mathieson, DuPont Howerton Gower and Columbia Southern or Columbia Chemical. The technical grade ingredients for the dusts formulated by Taylor Chemical during those years were DDT, benzene hexachloride (BHC) and copper. Significant concentrations of DDT, BHC, and copper have been found at the Twin Sites Area. Grower Service continued to use the Twin Sites Area during the years from 1964 through 1971 for disposal of dusts and granular finished products, as well as liquid pesticides and pesticide constituents, including xylenes and other pesticides wastes. Geigy Chemical used the Twin Sites Area in 1949 for disposal of dusts and pesticides wastes including DDT, BHC, and toxaphene. The RI/FS shows that a plume of contaminated groundwater originating from the Farm Chemicals Area flows underneath the Twin Sites Area.

The North Carolina State Division of Highways reported to the North Carolina Solid and Hazardous Waste Management Board (NC SHWMB), the first disposal area discovered at the Twin Sites Area in July 1984. On August 28, 1984, Mr. Flint Worrell of the NC SHWMB learned of another nearby disposal area through a Town of Aberdeen employee. These two disposal areas are referred to as Areas A and Area B. No records of waste disposal activities at the Twin Sites Area were maintained.

On October 22, 1984, a RCRA Hazardous Waste Site Inspection Team at the NC SHWMB conducted a site investigation at the Twin Sites Area. Pesticides bags and colored powdery material were strewn over Area A. Area B investigators noted strong odors were found in the area and observed that the moderately sloping terrain facilitated contaminant run-off towards Pages Lake. Samples of the wastes and soil collected from Areas A and B confirmed the presence of DDD, DDT, toxaphene, aldrin, heptachlor, lindane, dieldrin, and lead (AEPCO 1991).

In May 1986, following 1985 removal activities, EPA re-evaluated the Twin Sites Area and conducted geophysical surveys and limited groundwater and soil sampling in response to contamination found in four municipal and three private wells. No substantial trench structures or subsurface metallic debris were found to remain in Area A. Terrain conductivity findings did indicate the existence of a residual contaminant plume. A groundwater sample taken from the top of the water table near the center of Area A confirmed the residual plume. Soil samples from the northern edge of Area A showing concentrations of up to 19 ppm lindane and nearly 300 ppm for other BHC isomers were reported along with elevated levels of DDT, DDD, DDE, aldrin, heptachlor, endrin ketone, and chlordane.

In October 1987, during a reconnaissance, EPA discovered a third disposal area between disposal Areas A and B. Sulfur and pesticide-like odors were noticed during the site reconnaissance. During the subsequent RI, high levels of DDT, DDD, toxaphene, and alpha-, beta-, delta-, and gammaBHC were detected in samples collected from Area C.

In June and August 1985, the EPA Emergency and Remedial Response Branch (ERRB) initiated an emergency response cleanup at the Twin Sites Area. A total of 221 truckloads of contaminated soil and pesticide wastes were excavated from Areas A and B and shipped to the GSX facility at Pinewood, South Carolina for disposal.

Fairway Six Area

From 1950 through 1971, both Taylor Chemical and Grower Service used the Fairway Six Area for disposal of dusts and granular pesticide wastes as well as technical bags and containers. The bags were bundled and transported by truck up NC Highway 5 to the Fairway Six Area and spread over an undeveloped cleaned field about an acre in size. From 1950 through 1964, Taylor Chemical formulated commercial grade pesticide products for DuPont, Olin-Mathieson, Columbia Southern or Columbia Chemicals and Howerton Gowan. Grower Service continued Taylor Chemicals'

practice of disposal at the Fairway Six Area during its period of formulation for Union Carbide. During the early to mid-1950s, Geigy Chemical disposed of dusts and pesticide wastes including DDT, BHC, and toxaphene.

Correspondence recently obtained by EPA states that in March 1969, approximately 10,000 tons of chemical debris was buried at the Fairway Six Area. The material was buried in a hole 1000 feet long, 300 feet wide, and 40 feet deep.

Following subsequent transfer, Yadco of Pinehurst acquired the Fairway Six Area along with other property in the vicinity and sold part of the Fairway Six Area in 1984 to Partners who developed the "Pits Golf Links" golf course. The Fairway Six Area lies on the sixth fairway of the golf course and part of the Area is still owned by Yadco. NC SHWMB personnel discovered the Area in August 1984 through a tip from a Town of Aberdeen employee.

In October 1984, RCRA 3012 personnel of the NC SHWMB conducted a site investigation at the Fairway Six Area. During the investigation, household rubbish, old car parts, etc. were observed within the vicinity of the Area. It is believed that the area served as a trash dump for many years prior to the construction of the golf course. Records of waste disposal activity do not exist. Investigators discovered pesticide bags and noted colored powders and fines believed to be waste pesticides. A strong chemical odor was also noted. Analytical results of wastes and soil collected in October 1984 revealed the presence of 2,253 ppm DDT, 573 ppm DDD, 601 ppm toxaphene, and traces of lindane (EPA, 1991).

EPA initiated an emergency response action at the Fairway Six Area June 1985. Materials on the surface and in Trenches No. 1 and 2 were excavated and transported to the GSX facility in Pinewood, South Carolina for disposal. EPA re-evaluated the Area in May 1986. Geophysical surveys revealed a third buried trench (Trench No.3) ranging in depth from 4 to 10 feet and containing highly, conductive material. Exploratory augering and sampling verified the presence of pesticide contamination up to 1,500 ppm. Trench No. 3 was estimated to contain 12-million pounds of pesticide wastes.

During December 1986, the EPA Emergency Response Team (ERT) conducted a test burn of contaminated soil at the Area. A total of 12,000 pounds of material were incinerated in an 8-million BTU rotary kiln mobile incinerator owned and operated by Vesta Tech Ltd. An EPA Technical Assistance Team (TAT) conducted another EM-31 terrain conductivity survey at the Area in March 1987 and discovered a fourth pesticide trench (Trench No. 4) with pesticide contamination levels up to 1,500 ppm.

In August 1988, excavation of the pesticide wastes in Trench No. 3 and No. 4 began. Two additional pesticide waste trenches (No. 5 and No. 6) were discovered. These wastes were excavated, screened, and stockpiled adjacent to the Fairway Six Area. The stockpile located near the southeast corner, is isolated from the environment with both bottom and top liners of 30-mil PVC plastic that are chemically affixed to prevent migration of this material from the stockpile. The top liner is weighted down by rubber tires. The stockpile is roughly 215 ft. x 110 ft. x 28 ft. high and is enclosed by a 6-foot fence with a locked gate. It contains about 22,000 cubic yards of pesticide-contaminated materials.

The stock pile was designated as OU2 within the overall site strategy for the Site. AN FS was conducted for OU2 from March 1989 to May 1989 and a Record of Decision was signed on June 30, 1989. The selected remedy included on-site incineration.

The ROD for OU1 was signed on September 30, 1991. The selected remedy for OU1 includes thermal desorption, with incineration as a contingency alternative. A ROD amendment included in the September 30, 1991 decision changed the selected remedy for OU2 (redesignated as OU4) from incineration to thermal desorption, with incineration as a contingency alternative. OU1 and OU4 will be combined for centralized thermal treatment of contaminated soils as the Aberdeen Pesticide Dumps Site (EPA, 1991). A potentially responsible party (PRP) in receipt of a Unilateral Administrative Order, originally gave notice to EPA of their intent to comply with the Order to implement the remedy. Field activity was postponed however, pending the outcome of the remedy selection for OU1. The PRP undertook measures to ensure liner integrity of the soil

stockpile by replacing the top liner. In September 1991, EPA issued the ROD for OU1 and an Amended ROD for OU2. At this time OU2 was redesignated as OU4.

2.2 Enforcement Activities

The Aberdeen Pesticides Dumps Site was proposed for inclusion on the National Priorities List (NPL) in January 1987 and became final on the NPL at 54 Fed. Reg. 13301 (March 31, 1989). A potentially responsible party (PRP) search conducted in 1985 identified several PRPs. On May 15, 1985 and September 30, 1985, EPA notified the then-identified PRPs of the conditions at the Site and their potential liability for the costs of remediating such conditions. Certain information was also requested of the PRPs. The notified PRPs were also invited to participate in a removal of hazardous substances from the Site. No PRPs came forward to take action at the Site.

On April 13, 1987 EPA sent special notice letters to four identified PRPs and requested voluntary performance of a remedial investigation and feasibility study (RI/FS), to abate any release or threatened release of hazardous substances. None of the PRPs notified agreed to perform the requested work. EPA therefore proceeded to conduct the RI/FS utilizing the Superfund Trust money.

Following EPA's remedy selection of incineration for Operable Unit Two (OU2) contaminated soils contained in the Fairway Six Stockpile in June 1989, EPA issued special notice letters to twenty-two PRPs on December 21, 1989. The special notice letter invited PRPs to enter into negotiations for implementation of remedial action at OU2. Subsequently, EPA issued Unilateral Administrative Orders under CERCLA Section 106 to four PRPs during the week of March 5, 1990 directing them to perform the selected remedy for OU2. One PRP, Union Carbide, agreed to implement the selected remedy at OU2. However, upon agreement with EPA, implementation was delayed pending the issuance of a Record of Decision for Operable Unit One (OU1). OU1 addressed soil remediation at all five Areas of the Site.

On June 28, 1991, EPA issued a general notice letter to 19 PRPs. The notice letter provided an opportunity for the PRPs to meet with EPA to allow EPA to facilitate cooperation and coordination among all parties involved. On September 30, 1991 EPA issued a Record of Decision for OU1 and an Amended Record of Decision for Operable Unit Four (OU4) (a redesignation of OU2). Pursuant to CERCLA Section 122(e), special notice letters were issued to the PRPs which invited the PRPs to enter into negotiations for implementation of remedial design and remedial action (RD/RA) for OU1 and OU4. EPA was unable to reach a settlement with the PRPs for implementation of the RD/RA at the Site.

On December 1, 1992, an Explanation of Significant Differences (ESD) was issued by EPA to identify significant differences to the September 1991 ROD for OU1 and Amended ROD for OU4. The ESD provided information on activities that were not detailed in the ROD and Amended ROD and/or were being modified from the ROD and Amended ROD.

On May 20, 1993, EPA issued forty-four Unilateral Administrative Orders to twenty-two PRPs for implementation of RD/RA for OU1 and OU4. Many of the 22 PRPs received multiple orders representing work to be performed at each Area of the Site. Eleven respondents have given EPA their notice of intent to comply with the terms of the Order(s). Several respondents, while not agreeing to implement the RD/RA activities, have agreed to allow site access.

The Department of Justice (DOJ) filed a lawsuit on behalf of EPA Region IV against five defendants on March 31, 1989, pursuant to CERCLA Section 107 for recovery of past and future response costs. The suit is docketed as Civil Action No. C-89-231-R and was filed in the U.S. District Court for Middle District of North Carolina, Rockingham Division, Greensboro, North Carolina. As new information became available, the United States' complaint has twice been amended. Individuals and companies who are responsible for Site contamination are now named as defendants in the present cost recovery litigation.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

A Community Relations Plan for the Site was finalized in April 1988 and subsequently revised in January 1992. This document lists contacts and interested parties throughout government and the local community. It also establishes communication pathways to ensure timely dissemination of pertinent information.

Sections 113(k)(1) and 113(k)(2)(B)(i-v) of CERCLA, as amended by SARA, require EPA to establish an Administrative Record containing documents used to select response actions under CERCLA. All documents relating to OU3 were made available in the Administrative Record maintained in the information repository located at the Aberdeen Town Hall and at the EPA Region IV Record Center located in Atlanta, Georgia. A public comment period for OU3 was held from May 11, 1993 to July 10, 1993. A well attended public meeting was held on May 25, 1993 to present the results of the RI/FS and EPA's preferred alternative as presented in the Proposed Plan for OU3. A transcript of the May 25, 1993 public meeting is available for review in the Administrative Record.

In accordance with Section 117 of CERCLA, as amended by SARA, prior to the public meeting held on May 25, 1993, a public notice was provided in two local newspapers May 10-11, 1993. The public meeting was also announced in the Proposed Plan fact sheet which was distributed to approximately 350 interested parties on May 7, 1993. The Proposed Plan fact sheet briefly described the remedial alternatives analyzed, presented a preferred remedial action alternative and summarized the information relied upon to select the preferred alternative.

All written comments which were received by EPA prior to the end of the public comment period, including those expressed verbally at the public meeting, are addressed in the Responsiveness Summary which is Appendix A of this Record of Decision.

A very active citizens group, MooreFORCE, Inc. applied for and was awarded on September 25, 1992 a Technical Assistance Grant (TAG) in the amount of \$50,000. The purpose of the grant is to assist area residents in hiring a technical consultant to work with them during the Superfund process. More detailed information on community participation is found in Responsiveness Summary identified as Appendix A of this ROD.

4.0 SCOPE AND ROLE OF OPERABLE UNITS WITHIN SITE STRATEGY

As with many Superfund sites, the problems at the Aberdeen Pesticide Dumps Site are complex. As a result, EPA has organized the work into manageable components called Operable Units (OU).

Operable Unit One (OU1) addresses surface and subsurface soil contamination at the five areas comprising the Site: Farm Chemicals, Twin Sites, Fairway Six, McIver Dump, and Route 211. A ROD issued September 30, 1991, selected a final source control remedial action plan. Contaminated soil within this operable unit poses the principal threat to human health and the environment because of the risks from possible ingestion, inhalation or dermal contact with contaminated soils. The selected remedy involves excavation of contaminated soil, thermal treatment of that soil, and replacement of treated, non-hazardous residue into the excavated areas. This operable unit does not include the 22,000 cubic yard stockpile located at the Fairway Six Area.

Operable Unit Two (OU2) is now re-designated as Operable Unit Four.

Operable Unit Three (OU3) was designated for addressing groundwater, surface water and sediment contamination at three Areas comprising the Site: Farm Chemicals, Twin Sites and Fairway Six. In addition, OU3 addresses ecological concerns at these Areas

Operable Unit Four (OU4, formerly OU2) was designated for remediation of contaminated soil excavated in 1988 and now stored in the Fairway Six Area stockpile. A Record of Decision signed on June 30, 1989 selected on-site incineration of approximately 22,000 cubic yards of pesticide laden soil and debris and on-site disposal of the treated residuals. After receipt of a Unilateral Administrative Order in March 1990, Union Carbide gave notice to EPA of their intent to comply with the Order to implement the selected remedy. However, upon request by Union Carbide, EPA allowed a postponement of implementation of the selected remedy for OU4 pending the issuance of the Record of Decision for OU1. A ROD issued September 30, 1991 for OU1 also

amended the 1989 ROD for OU2 and re-designated the operable unit as OU4. The Amended ROD selected remedy involves thermal treatment of pesticide contaminated soils and replacement of treated, non-hazardous residue in the previously excavated trenches at the Fairway Six Area.

Operable Unit Five (OU5) was designated by EPA in which a remedial investigation and feasibility study will be conducted. OU5 will address groundwater, sediment, and surface water contamination, and assess ecological concerns at the McIver Dump and Route 211 Areas.

5.0 SUMMARY OF SITE CHARACTERISTICS

The following discussion is based on analytical results obtained during field investigations conducted from March 1989 through November 1992.

5.1 Surface Water Investigation

The surface water investigation illustrated in Figures 8 and 9 consisted of the following sampling network:

- 1 station 0.5 mile southeast of the Farm Chemicals Area
- 11 stations in the Twin Sites/Pages Lake Area (see Figure 9)
- 3 stations in the Fairway Six Area
- 4 stations along Aberdeen Creek
 - Regional background station: 2.5 miles upstream of Pages Lake
 - Between the confluence with stream from the lake at the Pit Golf Links and the Twin Sites/Pages Lake Area
 - 0.4 miles downstream of the dam at Pages Lake
 - 3.5 miles downstream of the Town of Aberdeen
- 2 stations along an eastern tributary to Aberdeen Creek whose confluence with the Creek is 0.1 mile downstream of the dam at Pages Lake

<Figure>

FIGURE 8 SURFACE WATER/SEDIMENT SAMPLING LOCATIONS

<Figure>

FIGURE 9 SURFACE WATER/SEDIMENT SAMPLING LOCATIONS IN THE TWIN SITES/PAGES LAKE AREA

All surface water samples were analyzed for TAL metals, VOCs, and pesticides/PCPs. Major findings from the remedial investigation of surface waters at OU3 of the Site are:

- The water quality of Aberdeen Creek does not appear to have been adversely affected by dumping activities at the Farm Chemicals Area.
- Localized VOC, metals, and pesticide contamination of the seep areas immediately downgradient of the Twin Sites Area include:
 - Pesticides detected were limited to the BHC isomers and low levels of endrin ketone and the suspected human carcinogens 4,4'-DDT and 4,4'-DDD.
 - Elevated levels of the VOCs, ethyl benzene, total xylenes, toluene, and 1,2-dichloroethane were detected in this area.

- Field measurements of pH revealed water from the seep areas to be acidic (pH less than 4.00). Concentrations of several metals were very elevated in these areas, although many were commonly found elements of low toxicity (calcium, iron, magnesium, potassium, and sodium). Aluminum was also extremely elevated, while manganese and zinc were elevated in comparison with concentrations at the regional background station.
- Sample results indicated that contamination of groundwater seeps near the Twin Sites Area adversely affects the water quality in at least one portion of Pages Lake. VOCs were not detected in the lake, but one contained a trace of alpha-BHC. Dilution effects have reduced pesticide contamination to non-detectable levels at both sampling stations downgradient of this area.
- Localized trace pesticide contamination was detected in surface waters immediately downgradient of the Fairway Six Area. Pesticides detected were limited to the BHC isomers (alpha and gamma), which are suspected human carcinogens. The concentrations of the BHC isomer exceeds the surface water Ambient Water Quality Criteria (AWQC).
- PCBs were not detected in any samples collected.

5.2 Sediment Investigation

The sediment sampling network was designed in conjunction with the surface water network to gather data to evaluate the actual or potential off-site contaminant migration via the sediment route. The sediment investigation consisted of the following sampling network (see Figures 8 & 9):

- 1 station 0.5 mile southeast of the Farm Chemicals Area
- 11 stations in the Twin Sites/Pages Lake Area
- 4 stations in the Fairway Six Area
- 4 stations along Aberdeen Creek
 - Regional background station: 2.5 miles upstream of Pages Lake
 - Between the confluence with stream from the lake at the Pit Golf Links and the Twin Sites/Pages Lake Area
 - 0.4 miles downstream of the dam at Pages Lake
 - 3.5 miles downstream of the Town of Aberdeen
- 2 stations along an eastern tributary to Aberdeen Creek whose confluence with the Creek is 0.1 mile downstream of the dam at Pages Lake

All sediment samples were analyzed for TAL metals, VOCs, and pesticides/PCBs. Based on the sediment sampling data, the following conclusion can be made:

- Sediments in the groundwater seeps downgradient of Area B of the Twin Sites Area and just west of Pages Lake are highly contaminated with the pesticides alpha-, beta-, delta-, and gamma-BHC; 4,4'-DDT and its daughter products, 4,4'-DDD and -DDE; and several VOCs, mainly ethyl benzene, toluene, and total xylenes. Concentrations were highest at the two southernmost sampling stations. Elevated concentrations of the potential human carcinogens tetrachloroethene and 1,2-dichloroethane were also found at the two southernmost sampling stations in the seeps. It appears that these stations are intercepting a plume of contaminated groundwater, with concentrations increasing towards the south.

- One station in Pages Lake revealed trace levels of the pesticide 4,4'-DDD. This station is the first one downgradient of the contaminated groundwater seeps near the western shore of the lake, which may indicate transport of this pesticide from that area.
- Elevated levels of aluminum, arsenic, chromium, iron, lead, vanadium, and zinc were found in the sediments of most stations in the seep areas.
- Five of the six stations in Pages Lake contained lead at concentrations over 3.5 times that found at the regional background station. The station near the dam was the only one in the lake which contained arsenic, beryllium, and an elevated level of chromium. Although the analytical results from samples SED-209, -210, -211, -212A, -213B and -214 in Pages Lake were rejected, chromium was detected at SED-213. It appears that arsenic, chromium, and lead may be migrating along the southwestern shore of Pages Lake to the area of the dam.
- The pesticides 4,4'-DDT, -DDD, and -DDE; beta- and delta-BHC; and dieldrin were detected at the station on Aberdeen Creek about 2,000 feet downstream of Pages Lake. Except for dieldrin, these pesticides were found immediately upstream in elevated levels in the groundwater seeps near the western shore of Pages Lake. It appears that these contaminants may be migrating along the southwestern shore of the lake to Aberdeen Creek, although they were not detected at the station closest to the dam. (Additional sampling along the western shore of Pages Lake and Aberdeen Creek may delineate this pathway).
- In comparison to the regional background station, elevated levels of aluminum, barium, chromium, iron, lead, and vanadium were found at all other stations along Aberdeen Creek. It appears that aluminum and chromium may be migrating from the Pages Lake Area to Aberdeen Creek. Elevated levels of lead found in the creek downstream of the Twin Sites/Pages Lake Area may be due to transport from that area and from a tributary to the east.
- Barium may be indigenous to sediments in the Aberdeen vicinity (it was found at 78 percent of the sampling stations, including the regional background station); although, compared with the level of barium at the regional background station, concentrations increased almost seven-fold at stations on Aberdeen Creek downgradient of the known areas of contamination. However, except for one station, these levels are still low (below twice the contract required quantitation limit [CRQL]) and are probably not significant.

5.3 Groundwater Investigation

The groundwater investigation involved the installation of permanent monitoring wells, piezometric wells and temporary monitoring wells. Figures 10 - 12 present the locations of these wells.

Multiple sampling events have occurred at the Farm Chemicals, Twin Sites and Fairway Six Areas for collection of groundwater data. During the RI phase, there were two rounds of groundwater sampling at the Areas. Groundwater samples were subsequently collected from the Areas in 1990 and 1992. These samples were analyzed for specific pesticide compounds which were not previously reported in the RI. These samples were analyzed for specific pesticide compounds which included disyston, dasanit, guthion, phorate, azodrin, DBCP, sevin, toxaphene and malathion.

<Figure>

FIGURE 10 MONITORING WELL LOCATIONS - FARM CHEMICALS AREA

<Figure>

FIGURE 11 MONITORING & PIEZOMETRIC WELL LOCATIONS- TWIN SITE

<Figure>

FIGURE 12 MONITORING & PIEZOMETRIC WELL LOCATIONS - FAIRWAY SIX AREA

Major findings from the remedial investigation pertaining to groundwater at the Farm Chemicals Area are:

- Groundwater underlying the area is contaminated with the BHC isomers, as all wells on-site revealed total levels of these pesticides ranging from 9.9 - 40 g/L. Lindane concentrations ranged from 3.5 - 10 g/L. Figure 13 shows the total BHC concentration plume at the Farm Chemicals/Twin Sites Areas.
- Groundwater flow is in an easterly direction across the Farm Chemicals Area, and concentrations of the BHC-isomers are highest in the farthest upgradient wells (1-MW-04 and -06) and decrease downgradient.
- Additional specific pesticides and volatiles were detected in groundwater at the Farm Chemicals Area during sampling conducted in November 1990. Toxaphene was detected at 19 g/L in GW-105 which was not detected in any sampling during the RI, but was confirmed at similar concentrations in EPA sampling conducted in March 1992. Toxaphene will be included as an additional contaminant of concern for the Farm Chemicals Area.
- Considering the soil sampling results from the RI and what is known about the pesticide formulation operations, several source areas are contributing contaminants to the groundwater. Several VOCs detected in on-site groundwater were also found in the background well, but concentrations on-site were generally greater than twice the background levels and are therefore considered significant.
- Additional point source areas may exist at the Farm Chemicals Area, which contribute different types of contaminants to the groundwater. The analyses of the specific pesticides by EPA during the additional sampling, showed significant contamination by other pesticides beyond those analyzed by CLP pesticide scan.
- VOCs have also contaminated groundwater beneath the Area. Toluene, ethyl benzene, and total xylenes were found in all wells onsite; most wells also contained tetrachloroethene, and 1,1,1-trichloroethane. Well 1 -MW-04 revealed the most contaminants with concentrations detected over 90,000 g/L of total VOCS, while levels of total VOCs in other on-site wells ranged from just under 400 g/L to over 7,700 g/L. Figure 14 shows the total VOC concentrations in groundwater at the Farm Chemicals/Twin Sites Areas.
- Trace amounts of several SVOCs were found in on-site wells; 1-MW-04 generally contained the highest levels.
- Metal concentrations in on-site groundwater were elevated and pH of this water was generally more acidic than that at the background well. Of the on-site wells, 1-MW-04 had the lowest pH (3.1) and also contained the highest concentration of metals.
- Round 2 groundwater sampling generally confirmed the findings of the Round 1 data. Overall, concentrations of the major contaminants in on-site groundwater were comparable, although concentrations of many were slightly lower than in Round 1. However, the pesticide aldrin, which was not detected in any on-site samples in Round 1, was detected as high as 5.2 g/L in Round 2 samples.
- Of the nine containers of unidentified liquids on-site that were sampled, only one contained pesticides (toxaphene), but most revealed elevated levels of VOCS.
- PCBs were not detected in any media sampled at the Farm Chemicals Area. The samples collected in March 1992 by EPA showed that all wells, including background wells,

contained detectable levels of VOCs. In addition, four of the six wells sampled at Farm Chemicals Area showed various concentrations of the specific non-CLP pesticides. One pesticide, DBCP was detected as high as 18,000 g/L in 1-MW-04.

<Figure>

FIGURE 13 CONTAMINATED GROUNDWATER PLUME WITH TOTAL BHC CONCENTRATIONS FARM CHEMICALS/TWIN SITES AREA Approximate Scale

<Figure>

FIGURE 14 TOTAL VOC CONCENTRATION-GROUNDWATER PLUME FARM CHEMICALS/TWIN SITES AREAS

Major findings of the Remedial Investigation and subsequent field investigations pertaining to groundwater at the Twin Sites Area are:

- All the sampling results indicate that Areas A, B, & C of the Twin Sites Area are still contaminated with pesticides. Area A is the most contaminated, with the greatest number of detections in each of the three media sampled, followed by Areas C and B. The groundwater station (2-MW-04) downgradient from Area B detected alpha-, beta-, and gamma-BHC (see Figure 13), while only alpha-BHC was detected in the surficial soil. The source for the beta- and gamma-BHC is probably Area C. The gamma-BHC (lindane) concentration detected in 2-MW-03, 2-MW-04, 2-PZ-01, and 2-PZ-02 exceeded the MCL of 0.2 g/L.
- VOCs were only detected in the eastern portion of the Area, downgradient of Areas B and C (see Figure 14). Ethyl benzene and total xylenes are the most concentrated of the four VOCs detected. The concentrations detected in the groundwater (including the seeps) were considerably higher than those detected in the subsurface soils of the two monitoring wells in this area (2-MW-02 and 2-MW-04), which indicates that the on-site soils may not be the sole source of the VOCs detected.
- Ethyl benzene and total xylenes were detected in subsurface soil and groundwater at the neighboring Farm Chemicals Area in high concentrations. A groundwater plume emanating from the Farm Chemicals Area is affecting the eastern portion of the Twin Sites Area, where similar contaminants were detected in the surface water/sediment samples collected from the groundwater seeps in the vicinity of well 2-MW-04 (the only sample that contained detectable VOCs). The analysis of these samples (SW-204 and SW-206) indicates the presence of a contaminated groundwater plume, the main constituents of which are the same as those in the plume originating at the Farm Chemicals plant.
- Based on the groundwater flow direction, Areas B and C of the Twin Sites Area may also be contributing to this contamination. The area of SW-208, however, is downgradient of the Farm Chemicals plant and the contamination there is related to the plume emanating from Farm Chemicals. Additional sampling is needed in the eastern portion of the Twin Sites Area to better delineate the source of the VOC contamination there.
- The metal concentrations detected on-site were more elevated than those detected in the background samples. This is probably the result of the relatively low pH (3.7-4.0) of groundwater. Except for the chromium and lead concentrations detected in 2PZ-01, none of the metal concentrations detected in the groundwater exceeded the MCLs.
- Five of the 13 soil samples collected by EPA at the Twin Sites Area during March 1992 contained toxaphene at concentrations that ranged between 700J g/kg and 1,200,000 g/kg. Sevin was detected in two soil samples at concentrations of 38,000 g/kg and 21,000 g/kg. No purgeable organic compounds were detected in the soil samples collected in March 1992.

- Two of the five wells sampled by EPA in March 1992 contained pesticides. Groundwater from monitor well 2-MW-02 contained 0.43 g/L of dasanit and 1.5J g/L of DBCP. The sample collected from 2-MW-04 contained dasanit (0.67 g/L), malathion (0.29 g/L), DBCP (3,500 g/L), sevin (0.98 g/L), and disyston (6.7J g/L), respectively.
- Purgeable organic compounds were detected in four of five wells sampled at the Twin Sites Areas during the March 1992 sampling as follows: trichlorofluoromethane, 1,2-dichloroethane, carbon tetrachloride, and tetrachloroethene were detected at concentrations ranging from 0.82J g/L to 5.8A g/L. The sample from 2-MW-04 contained the purgeable organics, ethyl benzene (340 g/L) and total xylenes (1,240 g/L).

Major findings from the Remedial Investigation and subsequent field investigations pertaining to groundwater at the Fairway Six Area are:

- Groundwater underlying the Area is contaminated with the pesticides alpha-, beta-, and delta-BHC; and, low concentrations (0.26 - 1.2 g/L) of lindane. Traces (less than 0.6 g/L) of nine other pesticides were detected. The deepest well screened from 109.5 - 119.5 feet below the ground surface, contained low levels (less than 1 g/L) of four other pesticides.
- The upgradient well 3-MW-01 revealed very low levels of two pesticides. Traces of 4,4'-DDT were found in the subsurface soil sample taken from the water table interval and in the groundwater sample. A trace of beta-BHC was also found in the groundwater. Concentrations of both pesticides in the groundwater sample were below 0.15 g/L; this may indicate another source of contamination upgradient of the known areas.
- 1,1,1-Trichloroethane was found in trace quantities in groundwater samples from all monitoring wells onsite, but a trace amount was also detected in the background well. Although most of these levels were below the CRDL, this may indicate a source upgradient of the areas of known contamination.
- Three VOCs were detected in subsurface soil samples collected from several borings onsite. Acetone was detected in both the above water table and water table samples from boring 3-MW-02, located just downgradient of Trench 3. Acetone was also found downgradient in the deepest soil samples taken from borings 3-MW-03 and -04; however, acetone was not detected in any groundwater samples. Carbon disulfide and a trace of benzene (1 g/kg) were found in the deepest soil sample taken from boring 3-MW-06. But, as with acetone, these contaminants were not found in any groundwater samples.
- PCBs were not detected in significant concentrations in any media sampled onsite.
- The analytical results from the November 1992 sampling revealed slightly elevated levels of pesticides in five wells, but not in the upgradient well. Beta-BHC (up to 34 g/L) and delta-BHC (up to 29 g/L) were detected in the highest concentrations. VOCs and SVOCs were detected at trace levels, and no PCBs were detected. Metals were found in all wells, including elevated levels in the background well (MW-1).
- The analytical data on the temporary wells indicated a significant amount of the contaminants exist beyond original area wells at the Fairway Six Area.

Table 2 provides a summary of the maximum contaminant concentrations detected in groundwater samples collected from the Farm Chemicals, Twin Sites and Fairway Six Areas.

5.4 Environmental Assessment

The major findings of the Final Environmental Assessment (EPA, 1993) are presented as follows:

- The western portion of Pages Lake in the vicinity of seeps associated with the Twin Sites Area is severely impacted. These impacts include elevated conductivity from 40 mho/cm (background) up to 1,000 mho/cm, and pH levels from about 5.6 down to 3.0. All media were found to be contaminated with metals and pesticides.
- Lindane (gamma-BHC) was found in two water samples at concentrations that exceeded the North Carolina water quality standard for this pesticide. The stations were in Aberdeen Creek upstream of the study area and in the Pit Links Golf Course Lake near the Fairway Six Area.
- Iron concentrations in water samples collected from one Aberdeen Creek station were equal to or exceeded the North Carolina water quality standard for iron.
- Pesticides such as DDT, DDD, DDE and BHC isomers were detected in sediments collected from six of the seven areas sampled. Although no standards or criteria exist for pesticides in sediments, contaminant concentrations are compared to background concentrations, and levels reported to have biological effects.
- The 1989 survey of benthic macroinvertebrates found low numbers of taxa in only two of the twelve stream stations sampled. One of the samples was collected from a Pages Lake tributary flowing through a residential area east of the lake, and is probably attributable to urban runoff or poor habitat.
- The *Dendrocopos borealis*, common name red-cockaded woodpecker, and other endangered species surveyed were not found in any of the Site study areas.

<Figure>

<Figure>

<Figure>

6.0 SUMMARY OF SITE RISKS

The Site is releasing contaminants to the environment. Actual or threatened releases of hazardous substances from OU3, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Chapter 6 of the remedial investigation report entitled "Baseline Risk Assessment" presents the results of a comprehensive human health risk assessment that addresses the potential threats to public health. Additional risk assessment documents which address the potential threats to the environment are contained in the Administrative Record for OU3.

The baseline risk assessment provides the basis for taking action and indicates the exposure pathways that need to be addressed by the remedial action. It serves as the baseline indicating what risks could exist if no action were taken at OU3. This section of the ROD summarizes the results of the baseline risk assessment conducted for OU3.

6.1 Contaminants of Concern

Data collected during the field investigations were reviewed and evaluated to determine the "contaminants of concern" at OU3 which are most likely to pose risks to public health. These contaminants were chosen for each environmental media sampled (e.g., groundwater, surface water, sediment) based on screening criteria including frequency of occurrence in each media, presence at levels considered to be greater than background, association with Site activities, either due to Site-related concentration gradients or through historical data on waste disposal, and comparison of levels found in quality control (QC) samples, if applicable.

The contaminants of concern at each Area of OU3 and the associated reasonable maximum exposure (RME) concentrations are given in Tables 3, 4 and 5. Concentrations are equal to the 95-percent upper confidence limit (UCL) on the arithmetic average, assuming that non-detects were equal to one-half the detection limit. If the UCL was greater than the maximum detected concentration, then the latter value was used for the exposure concentration.

- Sediment metal concentrations of arsenic, copper, lead and zinc in seep samples and Pages Lake stations near the seeps were found to be elevated. In addition, Pages Lake sediment aluminum and iron concentrations were elevated as much as 100-fold and 270-fold above background.
- Highly elevated concentrations of metals were found in water, sediment and aquatic plant samples collected from the seeps and the western portion of Pages Lake near the seeps. These high metals concentrations are being caused by the lowered pH observed in this area causing the least stable soil minerals to be dissolved. For example, aluminum concentrations in the lake are as high as 32 mg/l, about 140 times background, and iron and zinc in several seeps or lake stations near seeps exceeded either North Carolina water quality standards for aquatic life and EPA ambient water quality criteria for the protection of freshwater life.
- Seep sediment near Pages Lake contained DDT, DDD, DDE, and two BHC isomers.
- Sediment samples from at least four Pages Lake stations were toxic to the water flea, *Ceriodaphnia*, in a laboratory 7-day whole sediment toxicity test. Limited water flea toxicity was also found in Pages Lake water samples from the stations associated with seeps. However, due to the low pH of these samples, the pH had to be increased about 3 standard units prior to conducting toxicity tests. This resulted in the formation of precipitates, probably removing toxic agents from the water column. Water samples that were not pH adjusted were toxic to the fathead minnow and *Ceriodaphnia*, probably due to dissolved toxicants such as metals or the pH itself.
- Aquatic vegetation samples from Pages Lake near the seeps contained elevated concentrations of aluminum, arsenic, cadmium, iron, vanadium and zinc. All four BHC isomers, disulfoton, and DDD were also found in the plant samples collected near the seeps.
- The 1992 survey of benthic macroinvertebrates at lake stations found reduced number of taxa and low number of sensitive organisms at all Pages Lake stations in the vicinity of contaminated seeps along the western shore.
- Fish samples taken from Pages Lake contained DDD, DDT, DDE, and four isomers of BHC, including lindane. Fish collected in 1989 also contained endrin. Fish collected in 1992 contained up to 3 mg/kg of mercury.
- Fish sampled from the Pit Links Golf Course Lake contained DDT, DDE, DDD, and the four BHC isomers. Fish collected during 1992 contained up to 3 mg/kg of mercury.

6.2 Exposure Assessment

The exposure assessment identified potentially exposed populations in current and potential scenarios (e.g., worker currently working on site, adults and children living on site in the future). Table 6 provides the estimated exposure frequencies for the target populations under current and future land use scenarios. Table 7 provides the estimated ingestion rate per event.

The EPA-recommended exposure assumptions used for adults and children are:

Parameter	Child (under 6 yrs)	Adult
Body Weight (kg)	16	70
Respiratory vol. (m[3], 24 hr)	10	20
Skin surface area (cm[2])		
- hands	410	820
- arm	1,100	2,300
- legs	22,400	5,500
- whole body	7,280	19,400
Lifespan, residential (yrs)	70	70

The following exposure pathways were identified for the aqueous media present at or near the Site (groundwater and surface water):

- Ingestion of groundwater or surface water used as drinking water;
- Incidental ingestion of surface water while swimming;
- Dermal contact with groundwater or surface water during household use or summer activities; and
- Inhalation of volatilized chemicals from groundwater while showering.

<Figure>

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Three routes were identified by which exposure to contaminants of concern in the solid media (soil, sediment, dust, or fish) could occur:

- Incidental ingestion (e.g., eating with soiled hands);
- Dermal contact;
- Inhalation of airborne vapor or dust; and
- Ingestion of fish.

6.3 Toxicity Assessment

Under current EPA guidelines, the likelihood of adverse effects occurring in humans from carcinogens and noncarcinogens are considered separately. These are discussed below. Table 8 summarizes the carcinogenic and noncarcinogenic toxicity criteria for the contaminants of concern. The majority of the toxicological profiles presented in Table 8 were excerpted from Section 6.0 (Baseline Risk Assessment of the Final RI Report dated April 12, 1991, and Section 4.0 of the Supplemental RI Data Analysis Report, Addendum to Risk Assessment, April 15, 1991. Where available, additional profiles were provided for contaminants of concern which were added subsequent to the submittal of these documents.

Cancer slope factors have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Slope factors, which are expressed in units of (kg-day/mg), are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upperbound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upperbound" reflects the conservative estimate of the risks calculated from the slope factor. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived

from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied. These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

<Figure>

<Figure>

6.4 Risk Characterization

The risk characterization step of the Site risk assessment process integrates the toxicity and exposure assessments into quantitative and qualitative expressions of risk. The output of this process is a characterization of the Site-related potential noncarcinogenic and carcinogenic health effects.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ), or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose. By adding the HQs for all contaminants within a medium or across all media to which a given population may be reasonably exposed, the Hazard Index (HI) can be generated. Calculation of a HI in excess of unity indicates the potential for adverse health effects. Indices greater than one will be generated anytime intake for any of the contaminants of concern exceeds its Reference Dose (RfD). However, given a sufficient number of chemicals under consideration, it is also possible to generate a HI greater than one even if none of the individual chemical intakes exceeds their respective RfDs.

Carcinogenic risk is expressed as a probability of developing cancer as a result of lifetime exposure. Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. EPA's acceptable target range for carcinogenic risk is one-in-ten-thousand ($1E-4$) to one-in-one-million ($1E-6$).

Neither a cancer slope factor nor a reference dose is available for lead. Instead, blood lead concentrations have been accepted as the best measure of exposure to lead. The EPA has developed a biokinetic/uptake model to assess chronic and nonchronic exposures of children to lead. The uptake/biokinetic model estimates total lead uptake resulting from diet, inhalation, and ingestion of soil/dust, water, paint, and placental transport to the fetus. The uptake/biokinetic model calculates the uptake and blood lead levels for the most sensitive population, children ages 0 to 6 years old. EPA uses a blood lead level of 10 micrograms per deciliter (ug/dl) as the benchmark to evaluate lead exposure.

Under a future residential scenario a summary of the total lifetime excess cancer risks (LECR) and HIs for each Area are presented in Table 9. All of the LECR values for each Area fall outside of the lower end of EPA's acceptable risk range. DBCP is the major contributor to risk at the Farm Chemical/Twin Sites Areas via ingestion of groundwater. Inhalation of volatiles from groundwater is also a significant exposure pathway at the Twin Sites Area. Dermal exposure to pesticides in groundwater is the major source of carcinogenic risk at the Fairway Six Area. The HI values at the Farm Chemicals/Twin Sites Areas greatly exceed one while the non-carcinogenic risk at the Fairway Six Area did one. Tables 10 - 12 illustrate in detail the carcinogenic and non-carcinogenic risks at each Area under future residential scenarios.

<Figure>

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Current carcinogenic and non-carcinogenic risks are unacceptable at the Farm Chemicals Area under an on-site residential scenario. However, currently no one is residing at that Area. Non-carcinogenic risk under a current scenario exceeds one (2.0) for a child resident near the Twin Sites Area.

6.5 Risk Characterization Uncertainties

Methods in EPA's Superfund Risk Assessment Guidance (USEPA, 1989a) are used to characterize site risks. A conservative approach [reasonable maximum exposure (RME)] was used. This RME approach or scenario leads to conservative estimates of both chronic and subchronic daily intake of site-related contaminants; and thus the potential risk estimates. Nevertheless, quantitative risk estimate uncertainties may be associated with daily intake factors, toxicity criteria, other factors, or the Cowherd Air Particulates Modeling. Table 12a summarizes the uncertainties associated with quantitative risk estimates.

Three air samples were taken, one each for the Farm Chemicals, Twin, and Fairway Six Areas, and analyzed for pesticides only. As discussed, the Cowherd model was used to estimate the contaminant concentrations in air because of the lack of or inconsistencies in data on inorganics and organics. However, a quantitative risk uncertainty analysis was performed to determine the difference between the contaminant concentration estimated using the Cowherd model and those actually measured at the Site. Since inhalation RfDs for both chronic and subchronic effects are not available for all pesticides, only the carcinogenic risk is analyzed in this subsection.

With the exception of beta-BHC and gamma-BHC at the Farm Chemicals Area, the Cowherd estimated values were in general, two orders of magnitudes less than the actual measurements. Thus, the Cowherd estimated risk via inhalation of surficial soil could be underestimated by two orders of magnitude.

Farm Chemicals Area

The LECR for pesticides ranges from 3×10^{-7} to 3×10^{-10} (the total LECR is 1×10^{-4}). When three orders of magnitude are applied to the LECR for each pesticide, the total LECR is approximately 1×10^{-3} . Thus, the uncertainty for risk via inhalation of surficial soil at the Farm Chemicals Area is one order of magnitude.

Twin Sites Area

The LECR for pesticides ranges from 4×10^{-8} to 8×10^{-12} (the total LECR is 1×10^{-7}). When three orders of magnitude are applied to the LECR for each pesticide, the total LECR is approximately 5×10^{-5} . Thus, the uncertainty for risk via inhalation of surficial soil at the Twin Sites Area is two orders of magnitude.

<Figure>

Fairway Six Area

The LECR for pesticides ranges from 4×10^{-9} to 4×10^{-11} (the total LECR is 5×10^{-7}). When three orders of magnitude are applied to the LECR for each pesticide, the total LECR is approximately 9×10^{-6} . Thus, the uncertainty for risk via inhalation of surficial soil at the Fairway Six Area is one order of magnitude.

6.6 Summary of Ecological Risks

An ecological risk assessment was conducted by EPA to determine if residual pesticide contaminants would pose a risk to wildlife. An assessment was performed which evaluated risk to biota from exposure to soils with pesticide levels of 11 ppm DDT, 3 ppm BHC, 6 ppm toxaphene and 1 ppm dieldrin. Contaminants of concern chosen to calculate risk to biota were present at the highest concentrations in soils. Contaminant levels used to calculate risk to biota were based on established excavation and treatment performance standards for soils identified in the 1992

Explanation of Significant Differences to the Record of Decision for OU1 and the Amended Record of Decision for OU4 of the Site.

The choice of indicator species was based on species which potentially could be present at the contaminated areas. The chosen species include the meadow vole, white-tailed deer, robin, white-footed mouse, red-tailed hawk, and red fox, and were meant to be representative of the terrestrial food web and contaminant fate at the Areas. Assumptions in the risk assessment were made based on the literature as to the amount of chemicals which could potentially be incorporated into the food web. An assessment of the red-tailed hawk, white-tailed deer, and red fox was conducted using two scenarios, one based on a realistic site utilization value (these species would be expected to range over an area greater than that encompassed by the Site), and, for comparison, a second assessment using an unrealistic site utilization value of 100%.

The combined area of the Site is approximately 11 hectares. This risk assessment included two additional Areas of the Site, the McIver Dump and Route 211, which are not subject to this Record of Decision.

To estimate risk to wildlife, the hazard quotient method was utilized to compare exposure concentrations to ecological endpoints such as reproductive failure or reduced growth. The comparisons are expressed as ratios of potential intake values to population effect levels. A hazard quotient greater than 1 indicates that exposure to the contaminant may cause adverse effects in the organism.

Sources of uncertainty associated with the terrestrial risk assessment include:

- Risk assessment based solely on literature review.
- LOAEL values for related species were substituted in the risk calculations when LOAEL values were not available for the indicator species.
- LD[50]s were converted into LOAELs by dividing by ten.
- Biota was assumed to obtain 100% of diet from the Site.
- Carnivores were assumed to consume a diet of 100% white-footed mice which were calculated to contain higher contaminant levels than voles.
- The risk assessment does not take into account any synergistic or antagonistic effects caused by the mixture of pesticides found on the Site.

In general, the anticipated levels of contaminants which may remain at the Site are not expected to pose a severe ecological threat to wildlife utilizing the Site. The large home range sizes of animals evaluated in the risk assessment compared to the relatively small area of the Site indicate that exposure to pesticides is limited by the amount of time the animals would be expected to use this portion of their home range. DDT, at a concentration of 11 ppm in the soil, may pose a risk to robins, red-tailed hawks and small mammals ingesting food from these Areas. BHC and dieldrin are not expected to pose a risk to any wildlife utilizing the Site. BHC and dieldrin are not expected to pose a risk to any wildlife utilizing the Site. Table 13 presents results of the terrestrial risk assessment.

7.0 REMEDIAL ACTION OBJECTIVES

7.1 Remedial Action Objectives

Remedial action objectives for the contaminants of concern are discussed below.

Groundwater

The remedial action objectives for the contaminated groundwater at the Farm Chemicals, Twin Sites and Fairway Six Areas are presented below.

- Prevent human exposure (via ingestion and inhalation during showering) to groundwater containing total carcinogens at levels above the acceptable risk range of 10^{-4} to 10^{-6} .
- Prevent human exposure (via ingestion and inhalation during showering) to groundwater having a total level of non-carcinogens causing the HI to exceed the acceptable level of 1.0.
- Reduce groundwater contaminants to levels which are protective of the environment as specified in ARARs.
- Control future releases of contaminants to ensure protection of human health and the environment (SARA Section 121[d]).
- Permanently and significantly reduce mobility, toxicity, or volume of characteristic hazardous waste with treatment (SARA Section 121[d]).

<Figure>

Surface Water

Of the surface waters which were sampled during the RI at the Farm Chemicals and Twin Sites Areas, only those associated with the seep area downgradient of the Twin Sites Area were determined to pose a level of risk from the combined oral and dermal pathways at a risk level of 9×10^{-6} . The contamination present in the waters of the seeps is a manifestation of the surface discharge of the contaminated groundwater associated with plumes from the Farm Chemicals/Twin Sites Areas. Remediation of these plumes will reduce future contamination of the seeps; hence the risk posed by them. Therefore, the surface waters of these seeps would be cleaned up by source remediation.

Surface water samples were collected from the Pit Links Golf Course lake at the Fairway Six Area. Although minimal contamination was detected in these samples, the associated health risks are within acceptable levels. No remedial action is proposed for surface water in the Pit Links Golf Course Lake.

Sediment

Risk Assessment data on the contaminated sediment samples collected from the seeps at the Farm Chemicals/Twin Site Areas show risks to human health within the discretionary range of levels which are acceptable to EPA. The risks associated with the contaminated sediments in Pages Lake would be mitigated through natural attenuation, following soil cleanup activities in the Farm Chemicals/Twin Sites Areas.

Sediment samples were collected from the Pit Links Golf Course lake at the Fairway Six Area. Although minimal contamination was detected in these samples, the associated health risks are within acceptable levels. No remedial action is proposed for sediment in the Pit Links Golf Course Lake. Pending the collection and review of information obtained in the five-year review process, the need for additional action will be evaluated.

Ecological

Remedial goals for the surface water at OU3 are to be protective of both human health risk and environmental risks to ecological receptors. Environmental risks to ecological receptors shall be monitored and evaluated under the five-year review process.

Pending the collection and review of information obtained in the five-year review process, the need for additional action will be evaluated.

7.2 Extent of Contamination

Figure 15 shows the extent of the known contaminated groundwater plume at the Farm Chemicals/Twin Sites Areas. The extent of the known contaminated plume for the Fairway Six Area is shown on Figure 16. These plumes were estimated based on contamination levels detected in the subsurface soils and in the groundwater. At both Areas, the contaminated groundwater plumes have been estimated to extend over the entire study area. Only monitoring wells at the Twin Sites Area (Figure 15) where the concentrations were below detection levels for the organics of concern have not been included in the plume. These wells include 2-MW-01 and 2-MW-03.

Calculations were performed to estimate the volume of groundwater which may be subject to remediation. By using an estimated surface area of 2,270,000 square feet for the Farm Chemicals/Twin Sites Area, a saturated aquifer thickness of 24 feet (RI report-AEPCO, 1991) and an aquifer porosity of 30 percent, the quantity of contaminated water in one pore volume of the aquifer was estimated to be a minimum of 122.23 million gallons.

By using an estimated surface area of 200,000 square feet for the Fairway Six Area, a saturated aquifer thickness of 23 feet, and an aquifer porosity of 30 percent, the quantity of contaminated water in one pore volume of the aquifer was estimated to be a minimum of 10.3 million gallons.

8.0 DESCRIPTION OF ALTERNATIVES

The goal of remedial action at OU3 is to prevent, reduce or mitigate and minimize potential or current risks to public health, welfare, and the environment posed by contaminants at the Site. Technically applicable technologies that were judged to be potentially viable to meet the performance standards for OU3 were identified, screened, and assessed. These technologies were further evaluated and screened as to their effectiveness, implementability, and relative cost in comparison with other technologies that accomplish the same objective for the same media. Technologies surviving the initial screening were developed and screened further to eliminate those technologies that have adverse impact on human health and the environment, are not applicable to the contaminants and media at OU3, or are much more expensive to implement than other alternatives that provide essentially the same level of protection.

Contaminated groundwater at the Farm Chemicals/Twin Sites Areas contains volatile organic and semivolatile organic compounds, pesticides, and inorganics above acceptable levels. Remedial alternatives developed for the Farm Chemicals/Twin Sites Areas focused on removing or destroying these contaminants from the groundwater. Contaminated groundwater is migrating into Pages Lake and Aberdeen Creek. Extraction and removal of groundwater would minimize this migration into the adjacent lake. Contaminated surface water from the seeps would be extracted and treated with groundwater. No remedial action is proposed for surface water or sediment in Pages Lake or Aberdeen Creek.

<Figure>

<Figure>

Pesticides are of major concern in contaminated groundwater at the Fairway Six Area. Contaminant concentrations, although low, are not within acceptable levels. Remedial alternatives are targeted toward removing these contaminants from the groundwater.

The evaluation of alternatives generally involves developing a conceptual design for the corrective action and identifying key factors relating to the remediation. Tables 14 and 15 provide summaries of the remedial alternatives which were evaluated in detailed in the Feasibility Study. The remedial alternatives retained and evaluated in detail are discussed in the following sections.

8.1 Description of Alternatives for the Farm Chemicals/Twin Sites Areas

ALTERNATIVE 1: NO ACTION

This alternative provides the baseline case for comparing groundwater remedial actions and the level of improvement achieved. This alternative consists of leaving the contaminated groundwater as it is without conducting any further remedial actions. Although no action would be taken to contain or mitigate groundwater contamination, CERCLA Section 121(c) requires that if a remedial action is selected that results in any hazardous substances, pollutants, or contaminants remaining at the site, a review of the remedial action shall occur no less often than each 5 years after the initiation of the remedial action to assure that human health and the environment are being protected by the remedial action being implemented. Periodic, long-term monitoring would be included to assess the existing conditions at the Areas. Groundwater samples would be collected annually from each of the monitoring wells. Samples would be analyzed for VOCs, SVOCs, pesticides, and metals.

There are no capital costs associated with this alternative. Operating costs are based on the review of Site conditions every five years for a period of 30 years. This time period is used for cost purposes only and does not represent a determination as to the actual number of such reviews.

Total Capital Costs	\$0
Present Worth O&M Costs	\$342,197
Total Present Worth Costs	\$342,197

TABLE 14

**SUMMARY OF REMEDIAL ALTERNATIVES
FARM CHEMICALS/TWIN SITES AREAS
ABERDEEN PESTICIDE DUMPS SITE, NORTH CAROLINA**

Alternative 1	@	No Action
Alternative 2	@	In-situ Permeable Treatment Beds (with monitoring and deed restrictions) - inorganic adsorption media - organic adsorption media
Alternative 3	@	Extraction, Ex-situ Treatment, Discharge (with monitoring and deed restrictions)
Extraction	@	Extraction Wells and/or @ Interceptor Trenches
Pretreatment	@	Equalization/Neutralization
Inorganic Removal	@	Coagulation/Flocculation/Precipitation (sludge separation, dewatering, offsite disposal)
Organic Removal	@	Air Stripping (Alternative 3A) Treatment by incineration with acid gas scrubbing @ UV/H ₂ O ₂ /Ozone (Alternative 3B)
Post Treatment	@	GAC Adsorption (Liquid-phase) (with offsite regeneration of spent GAC)
Discharge Options	@	Infiltration Basin and/or Injection Well Recharge to Aquifer @ Discharge to Aberdeen Creek @ Discharge to POTW

TABLE 14
(Continued)
SUMMARY OF REMEDIAL ALTERNATIVES
FARM CHEMICALS/TWIN SITES AREAS
ABERDEEN PESTICIDE DUMPS SITE, NORTH CAROLINA

Alternative 4	@ Extraction, Volume Reduction, Discharge (with monitoring and deed restriction)
Extraction	@ Extraction Wells or Interceptor Trenches
Volume Reduction	@ Reverse Osmosis/Ultrafiltration (offsite concentrate disposal)
Discharge Option	@ Infiltration Basin and/or Injection Well Recharge to Aquifer
	@ Discharge to Aberdeen Creek
	@ Discharge to POTW

TABLE 15

**SUMMARY OF REMEDIAL ALTERNATIVES
FAIRWAY SIX AREA
ABERDEEN PESTICIDE DUMPS SITE, NORTH CAROLINA**

Alternative 1	No Action
Alternative 2	Limited Action @ Deed Restrictions @ Monitoring
Alternative 3	In-situ Permeable Treatment Beds @ organic adsorption media
Alternative 4	Extraction, Organic Removal, Discharge
Extraction	@ Extraction/Injection Wells
Pretreatment	@ Neutralization @ Equalization
Organic Removal	@ GAC Adsorption (liquid-phase) @ Offsite regeneration of spent GAC
Discharge Option	@ Surface Discharge to Aberdeen Creek @ Infiltration Basin and Injection Well Recharge to Aquifer @ Discharge to POTW
Alternative 5	Extraction, Volume Reduction, Discharge (with monitoring and deed restrictions)
Extraction	@ Extraction Wells
Volume Reduction	@ Reverse Osmosis/Ultrafiltration concentrate offsite treatment
Discharge Option	@ Discharge to Aberdeen Creek @ Infiltration Basin and Injection Well Recharge to Aquifer @ Discharge to POTW

ALTERNATIVE 2: IN-SITU PERMEABLE TREATMENT BEDS

This alternative represents the in-situ treatment option selected for groundwater remediation at the Farm Chemicals/Twin Sites Areas. In-situ adsorption media are available for both organic and inorganic removal. Both media would be necessary at the Farm Chemicals/Twin Sites Areas. Each treatment bed for the inorganic media would be approximately 10 feet in length and about 1 foot in width. The beds would be installed from about 5 feet above the water table (to account for water table variations) and extend to the confining layer. The adsorption media canisters for organic removal would be placed in 4-inch diameter wells (also called beds) screened from 5 feet above the water table to about 15 feet below the water table. For cost estimation purposes, it is assumed that the inorganic treatment beds would be placed in a staggered grid about 300 feet apart from each other, and the wells for the organic media would be placed in a grid about 100 feet apart. About 25 inorganic treatment beds and about 225 organic treatment wells are estimated at the Farm Chemicals/Twin Sites Areas under these assumptions. The actual spacing of the beds would be determined during the design phase after bench- and pilot-scale treatability studies.

Capital costs for this alternative would include site preparation and installation of the treatment beds. In addition, two upgradient and four downgradient monitoring wells would also be installed to assess the effectiveness of the treatment beds. The downgradient wells would be located close to the Aberdeen Creek and Pages Lake. O&M costs would include periodic replacement of the bed media. For costing purposes, it is assumed that bed media would be replaced once per month for a period of 30 years.

Total Capital Costs	\$ 3,075,765
Present Worth O&M Costs	\$15,983,476
Total Present Worth Costs	\$19,059,241

Groundwater remediation by in-situ permeable treatment beds is considered to be innovative as it has not been demonstrated on a full-scale level. Capital costs also include the cost for performing treatability studies to determine the size of the beds, number of beds, and the frequency of adsorption media replacement.

ALTERNATIVE 3A: EXTRACTION, ON-SITE TREATMENT BY COAGULATION/FLOCCULATION/PRECIPITATION, FOLLOWED BY AIR STRIPPING, GAC TREATMENT, AND DISCHARGE

This alternative represents the conventional pump and treat approach to groundwater remediation at the Farm Chemicals/Twin Sites Areas. Contaminated groundwater would be extracted and treated on-site for removal of organics and inorganics. Treated water would be discharged either on-site into the aquifer, off-site to Aberdeen Creek, or to a Public Owned Treatment Works (POTW) system. Discharge on-site by recharging the aquifer is preferred since it enhances the remediation process, and associated costs are included in the cost estimates.

Extraction of contaminated groundwater could be conducted either by extraction wells or by an interceptor trench, or a combination of both. The final extraction process option for remedial action could be determined during design after obtaining sufficient detailed data regarding the effectiveness and cost of each process option. Figure 17 shows the preliminary locations of extraction wells at the Farm Chemicals/Twin Sites Areas used for cost estimation. A thorough review of site data and aquifer modeling should be performed in order to establish well locations. Pump tests conducted at the site during the RI indicated a maximum rate of 18 gpm possible from extraction wells. Based on this data and experience in that geological region, a radius of influence of 90 to 100 feet is expected at an extraction rate of 10 gpm. Twenty-four, 6-inch diameter wells are proposed for cost estimation purposes, to yield a total of 240 gpm for treatment.

The wells would be installed such that the zone of influence would not affect Pages Lake.

An interceptor trench is expected to also be an effective option at the Farm Chemicals/Twin Sites Areas due to the close proximity to Pages Lake and the current migration of contamination into the lake. Figure 18 shows the proposed location of the interceptor trench, which would

preferably be used with injection wells and infiltration trenches as shown in Figure 17. The trench would be located about 150 feet from Pages Lake. Adequate controls would be required to ensure minimal backflow of water from Pages Lake. For estimating costs, it is assumed that the trench would be about 800 feet in length and extend about 60 to 70 feet to the confining layer. The length of the trench would be determined during the design phase and should be located to present a migration barrier to as much of the plume as possible and should include draw off points for groundwater. To preserve the railroad and road at the east side of the site, the trench would be supplemented with extraction wells.

Contaminated groundwater at the Farm Chemicals/Twin Sites Areas contains low concentrations of inorganics. Chromium, iron, manganese, and nickel are of major concern. These inorganics would potentially interfere with the organic treatment process. This alternative consists of a coagulation/flocculation/precipitation process to remove the metals. Groundwater at the site is acidic (pH 3 to 5), and would require equalization/neutralization as a pretreatment step. This step could be designed as part of the coagulation/flocculation/precipitation process. This treatment process would be designed for a rate of 240 gpm.

Effluent from the clarifier/sedimentation tank would undergo filtration before being pumped into the top of a stripping tower. A counter-current packed tower, or equivalent, is proposed, in which groundwater would flow downward through the packing material, while air is blown upward through the unit to exit at the top of the unit. The air stripping action is expected to remove most of the volatile organics from the contaminated water. Air containing the stripped contaminants would pass through a natural gas fired combustor and acid gas scrubber (due to the presence of chlorinated VOCs). In this situation, the cost of vapor phase GAC would be too high compared to combustion as a control technology (as much as approximately 150 lbs per day of VOCs would be emitted in the vapor stream by the stripper). The State of North Carolina imposes control measures on such emissions above 40 pounds per day.

<Figure>

FIGURE 17 PROPOSED GROUNDWATER TREATMENT SYSTEM FARM CHEMICALS/TWIN SITES AREAS

<Figure>

Treated water from the stripper would undergo a final polishing step, consisting of a water phase GAC adsorption unit, before discharge. Discharge options include on-site discharge into the aquifer through infiltration trenches and injection wells located upgradient (Figure 17), or off-site discharge into the Aberdeen Creek, or to a local POTW. The preferred method for remediation is discharge into the aquifer, since this method enhances the remediation of the area. Costs associated with discharge to the aquifer are included in this alternative. Fifteen injection wells and three infiltration trenches are shown in Figure 17 upgradient of these areas to increase the flux of water through the aquifer, and for estimating purposes are envisioned to be used together. The design phase will determine the exact discharge system to use, and the amount of water to recharge and discharge.

Residuals generated during this alternative include the metal-contaminated sludge from the precipitation process and the liquid-phase GAC from the polishing step. Sludge would be dewatered using filter presses, and then disposed off-site using appropriate methods. Spent GAC would be taken off-site for regeneration and reuse.

Capital costs for this alternative include installation of the extraction and recharge systems (extraction wells or interceptor trench), initial site preparation, mobilization, and installation of the on-site treatment units. The O&M costs would include operation of the treatment units, periodic replacement of the GAC adsorption columns, discharge of treated water, and residuals management. The minimum amount of contaminated groundwater (one pore volume) at the Farm Chemicals/Twin Sites Areas is estimated at 122.5 million gallons (MG). The continuous flushing model given in "Guidance on Remedial Actions for Contaminated Groundwater" (EPA/540/G-88/003 Appendix D) was performed based on DBCP, and this contaminant requiring a reduction factor of 100,000 times. Based on a 240 gpm extraction rate, this modeling yielded a theoretical pumping time of 14 years. Based on Agency experience, this period is likely to be a

minimum time with the upper limit being 30 years.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$ 2,235,695
Present Worth O&M Costs	\$ 4,951,770
Total Present Worth Costs	\$ 7,187,465

ALTERNATIVE 3B: EXTRACTION, ON-SITE TREATMENT BY COAGULATION/FLOCCULATION/PRECPITATION, AND ULTRAVIOLET/HYDROGEN PEROXIDE/OZONE, GAC TREATMENT, AND DISCHARGE

This alternative is identical to Alternative 3A except for oxidation of organics by hydrogen peroxide and ozone in the presence of UV radiation, instead of removal of organics by air stripping. Oxidation of organics by UV/hydrogen peroxide/ozone is considered an innovative technology for treatment of contaminated groundwater. The system consists of a treatment tank module, an air compressor and an ozone generator module, and a hydrogen peroxide feed system. The treatment tank size, the UV intensity, the ozone and hydrogen peroxide doses would be determined during pilot-scale studies. Residual ozone from the treatment tank passes through an ozone (decompozon) destruction unit before air venting. Volatile organics stripped off in the treatment tank are also destroyed in the decompozon unit. The technology is fully commercial, and skid-mounted portable units of various capacities are available for on-site treatment. For cost estimation purposes, a 240-gpm unit would be installed on-site for groundwater treatment with a GAC polishing unit following the oxidation unit.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$ 2,470,545
Present Worth O&M Costs	\$ 4,637,669
Total Present Worth Costs	\$ 7,108,214

ALTERNATIVE 4: EXTRACTION, ON-SITE TREATMENT BY REVERSE OSMOSIS/ULTRAFILTRATION, AND DISCHARGE

This alternative represents a volume-reduction approach for groundwater remediation at the Farm Chemicals/Twin Sites Areas. Contaminated groundwater would be extracted by extraction wells or interceptor trenches as discussed in Alternative 3A. Extracted water would pass through a system using a combination of reverse osmosis and ultrafiltration treatment. The ultrafiltration process removes most of the relatively large constituents of the process stream before the reverse osmosis application selectively removes the water from the remaining mixture. A disc tube design proposed under this alternative is expected to allow for easy cleaning of the filtration media, providing a long service life for the membrane components of the system. The unit consists of a skid-mounted treatment tank and a high-pressure feed system comprising a centrifugal feed pump, a prefilter cartridge housing, and a triplex plunger pump to feed the reverse osmosis/ultrafiltration modules.

The treated stream from this alternative is expected to be of a relatively high purity, and is not expected to require a GAC polishing step (as in Alternatives 3A and 3B). A 200 gpm unit is proposed for the Areas. A volume reduction of 100 was assumed (for cost purposes assuming the most optimistic, lowest-cost basis; this factor must be determined in treatability tests). It is also assumed that the concentrate would be transported to an off-site treatment and disposal facility. Treated water would be recharged to the aquifer as in Alternative 3A (preferably) with the other discharge options possible.

Capital costs for this alternative would include site preparation, installation of extraction and recharge systems and mobilization of a portable reverse osmosis/ultrafiltration unit onsite. O&M costs would include extraction of groundwater, operation of the treatment unit, periodic transportation of concentrated residuals for off-site treatment, periodic replacement of the semipermeable membranes, and analysis of groundwater samples to monitor effectiveness of the technology and residual groundwater contamination.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$ 2,958,725
Present Worth O&M Costs	\$30,661,751
Total Present Worth Costs	\$33,620,476

8.2 Description of Alternatives for the Fairway Six Area

ALTERNATIVE 1: NO ACTION

This No Action alternative provides the baseline case for comparing groundwater remedial actions and the level of improvement achieved. This alternative consists of leaving the contaminated groundwater as it is without conducting any further remedial actions. Periodic monitoring would be included to assess the existing conditions at the Area. Groundwater samples would be collected annually from each of the monitoring wells. Samples would be analyzed for VOCs, SVOCS, pesticides, and metals. A public health risk assessment would be conducted once every five years under CERCLA Section 121(c).

There are no capital costs associated with this alternative. Operating costs are based on the review of Site conditions every five years for a period of 30 years.

Total Capital Costs	\$0
Present Worth O&M Costs	\$342,197
Total Present Worth Costs	\$342,197

ALTERNATIVE 2: LIMITED ACTION

This alternative constitutes the limited action. Although no action would be taken to remediate the contaminated groundwater at the area, restrictions would be imposed to minimize use of the contaminated groundwater. The risk assessment study performed at the Area indicated that there are no on-site residents at the Area. Part of the property along the golf course, however, is privately owned and likely to be developed for residential use. The groundwater does not pose any current risks to the on-site workers or recreational users of the golf course. However, under a future residential use scenario an unacceptable carcinogenic risk would be expected from exposure through all pathways. Because of likely future residential use, a residential scenario basis has been used. The source of contamination into groundwater, which is contaminated soil, will be removed under OU1. Contamination levels in the groundwater plume would gradually reduce due to natural attenuation and biodegradation.

Capital costs for this alternative would include installing a fence around the contaminated plume at the Fairway Six Area. Warning signs would be erected around the Area and near the tributary to Aberdeen Creek adjacent to the Area, to minimize public use of the creek for swimming and fishing purposes. O&M costs would include periodic groundwater sampling and analysis. A public health assessment would also be conducted every five years to evaluate the existing risks.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$ 55,440
Present Worth O&M Costs	\$342,197
Total Present Worth Costs	\$397,637

ALTERNATIVE 3: IN-SITU PERMEABLE TREATMENT BEDS

This alternative represents the in-situ selected treatment option for evaluation for groundwater remediation at the Fairway Six Area with a residential use basis. In-situ adsorption media are available for both organic and inorganic removal. Only the organic adsorption media would be necessary at the Fairway Six Area, because only pesticides are of primary concern. Adsorption media canisters for organic removal would be placed in 4-inch diameter wells (also called beds) screened from 5 feet above the water table to about 15 feet below the water table. For cost

estimation purposes, it is assumed that the wells for the organic media would be placed in a grid about 100 feet apart. About 100 organic treatment wells would be required under these assumptions. The actual spacing of the wells would be determined during the remedial design after bench and pilot-scale treatability studies.

Capital costs for this alternative would include site preparation, installation of the treatment wells, and recharge of treated water to enhance the remediation. The specific location and number of wells and infiltration trenches must be determined in the remedial as well as the amount of treated water to recharge to the aquifer. In addition, two upgradient and four downgradient monitoring wells would also be installed to assess the effectiveness of the in-situ treatment beds. O&M costs would include periodic replacement of the bed media. For costing purposes, it is assumed that bed media would be replaced once every month. The time required to operate the in-situ beds is difficult to estimate, due to the lack of design information.

Groundwater remediation by in-situ permeable treatment beds is considered to be innovative as it has not been demonstrated on a full scale. Capital costs include the cost for performing limited treatability studies to determine the size of the beds, number of beds, and the frequency of adsorption media replacement.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$ 1,804,110
Present Worth O&M Costs	\$11,100,733
Total Present Worth Costs	\$12,904,843

ALTERNATIVE 4: EXTRACTION, GAC ADSORPTION, DISCHARGE

This alternative represents the conventional pump and treat approach to groundwater remediation at the Fairway Six Area. Contaminated groundwater would be extracted and treated on-site for removal of organics. Treated water would preferably be recharged on-site into the aquifer, or discharged off-site to either Aberdeen Creek or to a POTW serving the golf course.

Extraction of contaminated groundwater would be conducted by extraction wells. The wells would cover the known plume area (approximately 200,000 square feet), which must be fully assessed and delineated for RD. The approach using a recharge system for treated water would enhance the remediation. The specific location, number, and size of extraction and discharge wells and infiltration trenches, as well as the amount of treated water recharged to the aquifer, must be determined in the remedial design for this area. Figure 19 shows the preliminary locations of wells at the Fairway Six Area. Pump tests conducted at the Area during the RI indicated a maximum rate of 5 gpm possible from extraction wells. A radius of influence of 90 to 100 feet is expected, based on the data and regional geophysical experience, at an extraction rate of 3 gpm. Twenty 6-inch diameter wells are proposed for cost purposes, to yield a total of 60 gpm for treatment. Twelve recharge wells and 6 trenches have been shown located on Figure 19 to provide a preliminary basis for cost estimation. These wells and trenches are located upgradient of the source areas to increase water flux through the contaminated aquifer. The necessity for equalization/neutralization as pretreatment before organic removal by GAC adsorption will be determined during remedial design. The treatment process would be designed for a maximum rate of 60 gpm. Residuals generated during this alternative include spent GAC from the primary treatment of organics. Spent GAC would be taken off-site for regeneration and reuse.

<Figure>

FIGURE 19 PROPOSED GROUNDWATER TREATMENT SYSTEM FAIRWAY SIX AREA

The minimum amount of contaminated groundwater (one pore volume) at the Fairway Six Area is estimated at 10.3 MG. The continuous flushing model given in "Guidance on Remedial Actions for Contaminated Groundwater" (EPA/540/G-88/003 Appendix D) was performed based on reducing gamma-BHC (Lindane) from 1.2 ppb to 0.0265 ppb. This modeling yielded a theoretical operating time of 1 year. Based on EPA experience, this period is likely to be a minimum time with the

upper limit being 30 years.

Capital costs for this alternative include installation of the extraction and recharge systems (including interceptor trenches), initial site preparation, mobilization, and installation of the on-site treatment units. The O&M costs would include operation of the treatment units, periodic replacement of the GAC adsorption columns, discharge of treated water, and residual management.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$1,267,420
Present Worth O&M Costs	\$3,394,872
Total Present Worth Costs	\$4,662,292

ALTERNATIVE 5: EXTRACTION, REVERSE OSMOSIS/ULTRAFILTRATION, DISCHARGE

This alternative represents a volume-reduction approach for groundwater remediation at the Fairway Six Area. Contaminated groundwater would be extracted by extraction wells as discussed in Alternative 4. Extracted water passes through a system using a combination of reverse osmosis and ultrafiltration treatment. The ultrafiltration process removes most of the relatively large constituents of the process stream before the reverse osmosis application selectively removes the water from the remaining mixture. A disc tube design proposed under this alternative is expected to allow for easy cleaning of the filtration media, providing a long service life for the membrane components of the system. The unit consists of a skid-mounted treatment tank and a high-pressure feed system comprising a centrifugal feed pump, a prefilter cartridge housing, and a triplex plunger pump to feed the reverse osmosis/ultrafiltration modules.

The treated stream from this alternative is expected to be of a relatively high purity but must be verified in treatability tests. A 60 gpm unit is proposed for the Area. A volume reduction of 100 was assumed (for cost purposes assuming the most optimistic, lowest cost basis; this factor must be determined in treatability tests). It is also assumed that the concentrate would be transported to an off-site treatment and disposal facility. It is possible that the concentrate could be treated on-site with contaminated soil in the thermal treatment unit, which is the selected remedy for OU1 contaminated soil remediation. It is also assumed for this alternative that the treated water would be of sufficient quality to recharge to the aquifer as in Alternative 4 to enhance the remediation.

Capital costs for this alternative would include site preparation, installation of extraction wells and interceptor trenches, and mobilization of a portable reverse osmosis/ultrafiltration unit on-site. O&M costs would include extraction of groundwater, operation of the treatment unit, periodic transportation of concentrated residuals for off-site treatment, periodic replacement of the semipermeable membranes, and analysis of groundwater samples to monitor effectiveness of the technology and residual groundwater contamination.

Total Present Worth Costs representing 30 years of operation include:

Total Capital Costs	\$1,744,820
Present Worth O&M Costs	\$6,046,899
Total Present Worth Costs	\$7,791,719

9.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedial alternatives developed for OU3 during the FS were evaluated by the U.S. EPA and the NCDEHNR using nine criteria, pursuant to the NCP, 40 C.F.R. [Para] 300.430(e)(9)(iii) and 40 C.F.R. [Para] 300.430(f)(1)(i). The advantages and disadvantages of each alternative were then compared to identify the alternative providing the best balance among these nine criteria defined below.

Threshold Criteria

- (1) Overall Protection of Human Health and the Environment assesses whether an alternative provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- (2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) assesses whether an alternative will meet Federal and State ARARs or justifies a waiver.

Primary Balancing Criteria

- (3) Long-term Effectiveness and Permanence assesses the expected residual risk and the ability of an alternative to maintain reliable systems and controls necessary for the protection of human health and environment over time, once clean up goals have been met.
- (4) Reduction of Toxicity, Mobility or Volume Through Treatment assesses the anticipated performance of the treatment technologies an alternative may employ.
- (5) Short-term Effectiveness involves the period of time needed to achieve protection and assesses any adverse impacts on human health and the environment that may be posed during the construction and implementation period, until performance standards are achieved.
- (6) Implementability assesses the technical and administrative feasibility of an alternative, including the availability of materials and services needed to implement a particular option.
- (7) Cost assesses estimated capital, annual operation and maintenance, and net present value of capital and operation maintenance.

Modifying Criteria

- (8) State Acceptance assesses State concerns related to the alternatives and the State's comments on ARARs or the proposed use of waivers.
- (9) Community Acceptance assesses the public's response to the alternatives described in the Proposed Plan, RI/FS Reports and Administrative Record. The specific responses to public comments are addressed in the Responsiveness Summary attached to this document.

Alternative 1, the No Action alternative was retained as a baseline for comparison with other alternatives as required by the NCP. This alternative was retained for both the Farm Chemicals/Twin Sites Areas and the Fairway Six Area. Alternative 2 is a limited action alternative to restrict use of contaminated groundwater by imposing deed restrictions at the Fairway six Area. An in-situ approach to removing organic and inorganic contaminants by groundwater flow through adsorption beds was retained as Alternatives 2 and 3 for the Farm Chemicals/Twin Sites Areas and the Fairway Six Area, respectively. The time estimated to achieve remedial goals using the in-situ alternative is speculative due to the lack of performance data.

For the Farm Chemicals/Twin Sites Areas Alternatives 3A, 3B and 4 represent the pump and treat approach to groundwater remediation. Groundwater would be extracted by extraction wells or interceptor trenches or a combination of both. In Alternatives 3A and 3B, inorganics would be removed by a coagulation/flocculation/precipitation process.

Contaminated metal sludge from precipitation would undergo off-site disposal. In Alternative 3A, the organics would be removed by air stripping, while in 3B, they would be destroyed by UV/hydrogen peroxide/ozone treatment. In Alternative 4, the volume of contaminated groundwater would be reduced by a reverse osmosis/ultrafiltration process, and the concentrate would be transported off-site to a treatment facility. Alternatives 3A and 3B also include a GAC polishing step of the treated groundwater before final discharge.

A cost comparison for an extraction well system and an interceptor trench was performed for the

Farm Chemicals/Twin Sites Areas. The results indicate the costs for these areas may be approximately equivalent. Because of the apparent cost equivalence, extraction systems and interceptor trench systems were not presented as separate alternatives, but were presented as options within an alternative. Costs associated with each alternative are summarized on Table 16 for each Area.

Alternatives 4 and 5 for the Fairway Six Area represent the pump and treat approach to groundwater remediation. Groundwater would be removed from the aquifer by extraction wells. In Alternative 4, the organics would be removed by GAC adsorption. Alternative 5 would involve a volume reduction in contaminated groundwater by reverse osmosis/ultrafiltration process, and the concentrate would be transport off-site to a treatment facility.

Discharge options for treated groundwater at the three Areas include on-site recharge into the aquifer through upgradient infiltration trenches, or off-site discharge to either Aberdeen Creek or a nearby POTW. The preferred option is discharge to infiltration basins.

A summary of the detailed analysis of remedial alternatives for groundwater remediation for each Area are presented in Tables 17 & 18.

10.0 THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives using the nine criteria, including and public and State comments, EPA has determined that Alternative 3A (extraction, on-site treatment by coagulation/flocculation/precipitation, air stripping, GAC adsorption, and discharge on-site) for the Farm Chemicals/Twin Sites Areas and Alternative 4 (extraction, on-site treatment by GAC adsorption and discharge on-site) for the Fairway Six Area is the most appropriate remedy for OU3 of the Site. At the completion of this remedial action, the risk associated with OU3 has been calculated to be within the accepted risk range determined to be protective of human health and the environment. Assuming 30 years of operation and maintenance, the total present worth cost estimate for OU3 is \$11,849,757. Tables 19 and 20 provide a summary detailing the cost estimates for Alternatives 3A and 4.

<Figure>

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Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA, as amended by SARA, requires that remedial actions comply with requirements or standards set forth under Federal and State environmental laws. The requirements that must be complied with are those that are applicable or relevant and appropriate (ARAR) to the (1) remedial action(s), (2) location, and (3) media-specific contaminants at the Site.

Applicable requirements defined in 40 C.F.R. [Para] 300.400(g)(1) are those requirements applicable to the release or remedial action contemplated based upon an objective determination of whether the requirement specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. These requirements would have to be met under any circumstance. Relevant and appropriate requirements defined in 40 C.F.R. [Para] 300.400(g)(2) are those requirements that address problems or situations sufficiently similar to the circumstances of the release or removal action contemplated, and whether the requirement is well suited to the Site. Chemical-, location-, and action-specific ARARs are listed in Table 21.

Pre-Design Activities

The final extraction process option for remedial action at the Farm Chemicals/Twin Sites Areas

will be determined during design after obtaining sufficient detailed data regarding the effectiveness and cost of each process option. The extraction process may consist of extraction wells, interceptor trenches, or a combination of both. A thorough review of site data and aquifer modeling will be performed in order to establish well locations. The length of the trench will be determined during the design phase and will be located to present a migration barrier to as much of the plume as possible and will include draw off points for groundwater. Design parameters shall also include a geotechnical evaluation to assess the potential damage which could occur to the pavements and railroad as a result of foundation settlement which occurs during the lowering of the water table. Documentation and monitoring of structural pavement integrity shall be performed before initiation of groundwater extraction and continued throughout the extraction process.

The Fairway Six Area groundwater plume must be fully assessed and delineated during remedial design. The specific location, number, and size of extraction wells, as the type of discharge system, must be determined in the RD for this Area. The necessity for equalization/neutralization as pretreatment before organic removal by GAC adsorption at the Fairway Six Area will also be determined during remedial design.

<Figure>

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The design phase for Farm Chemicals/Twin Sites and Fairway Six Areas will determine the exact discharge system and parameters of that system.

Pre-design activities shall include sampling of existing monitoring wells and analysis for dioxin and dibenzofuran contaminants at OU3. If dioxins and dibenzofurans are found to be present in the groundwater, the EPA may require:

- 1) minimization of the effects of phenolic compounds which could form dioxins and dibenzofurans by initiating a granular activated carbon adsorption treatment of the extracted groundwater prior to air stripping,
- 2) a treatability study to evaluate the potential of dioxin formation from an off-gas thermal treatment process,
- 3) modification to the air stripper emission control system, and
- 4) as appropriate, proper handling, transportation and disposal procedures.

Groundwater Extraction

The process by which groundwater will be removed from the aquifer across the Farm Chemicals, Twin Sites and Fairway Six Areas will be determined during design. Additional design details will provide justification for the selection of either extraction wells, interceptor trenches or a combination of the two processes for removal of contaminated groundwater from the aquifer. Location of extraction wells and/or interceptor trenches and the resulting pumping rates will be determined during the remedial design.

Groundwater Treatment

Remediation will address the contaminated groundwater at the Farm Chemicals, Twin Sites and Fairway Six Areas. Alternatives 3A and 4 represent the conventional pump and treat approach to groundwater remediation.

At the Farm Chemicals/Twin Sites Area, groundwater will be treated by a treatment train consisting of the following:

- pretreatment consisting of equalization and neutralization
- coagulation/flocculation/precipitation to remove inorganics
- air stripping to remove volatile organic compounds
- granulated activated carbon adsorption to remove other organics from the liquid-phase

The Fairway Six Area treatment train will consist of the following components:

- pretreatment consisting of equalization and neutralization, as appropriate
- treatment of contaminated groundwater using granular activated carbon adsorption

The goal of this remedial action is to restore groundwater to its beneficial use, which is, at this Site, a drinking water source. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, EPA believes that the selected remedy will achieve this goal. It may become apparent, during implementation or operation of the groundwater extraction system and its modifications, that contaminant levels have ceased to decline and are remaining constant at levels higher than the performance standards over some portion of the contaminated plume. In such a case, the system performance standards and/or remedy may be re-evaluated.

The selected remedy will include groundwater extraction, during which time the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modifications may include any or all of the following:

- a) at individual wells where performance standards have been attained, pumping may be discontinued;
- b) alternating pumping at wells to eliminate stagnation points;
- c) pulse pumping to allow aquifer equilibration and to allow adsorbed contaminants to partition into groundwater; and
- d) installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To ensure that performance standards continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased on an occurrence of at least every 2 years following discontinuation of groundwater extraction.

Groundwater Discharge

The preferred option for discharge of treated groundwater is infiltration into the aquifer via infiltration basins and/or injection wells located upgradient. Note however, in accordance with North Carolina regulations, it must be shown that injected groundwater would be contained within a closed loop system in order to consider injection wells as a feasible disposal option for treated groundwater. This option is preferable since it is expected to enhance the remediation process. Associated costs are included in the cost estimates. However, should it be determined more cost effective or feasible to discharge to Aberdeen Creek or to the local POTW, these options may be considered during the remedial design phase. Any water discharged off-site to a surface water body must meet the National Pollutant Discharge Elimination System (NPDES) and POTW permit limits.

Performance Standards

Groundwater shall be treated until the groundwater remediation performance standards are

attained throughout the contaminant plume. These standards are identified in Table 22.

Residuals Management

Management of residuals generated during the treatment process shall include:

- De-watering of metal-contaminated sludge from the precipitation process and disposal off-site.
- Passing air containing the stripped contaminants through a combustor and an acid gas scrubber.
- Off-site disposal, regeneration, or reuse of spent GAC from the liquid-phase GAC polishing step.

Ecological Considerations

Due to the documented hazard quotients which exceed one in the terrestrial risk assessment for certain wildlife utilizing the Site, consideration must be given to provide adequate protection of the environment.

No action is recommended at this time to address contaminated sediment and surface water at OU3. The Agency anticipates that thermal treatment of contaminated soil and conventional pump-and-treat of contaminated groundwater will alleviate the source for contamination in surface water and sediments. Moreover, the contamination present in the waters of the seep areas is a manifestation of the surface discharge of the contaminated groundwater associated with the plumes from the Farm chemicals Twin Sites Areas. Remediation of these plumes via pump-and-treat will reduce future contamination of surface waters in the seep areas.

Under the five-year review process, monitoring will be carried out to assess the effectiveness of groundwater remediation in mitigating impacts to surface water, sediment and biota. The five-year review will address the terrestrial and avian receptor pathways. Monitoring of ecological effects will be conducted to address the success of the remedy, as well as determine the necessity of additional action. The monitoring shall consist of, but not limited to, adequate sampling points to define VOC contamination in the eastern portion of the Twin Sites Area and the affected southwestern corner of Pages Lake. Prior to commencement of any physical activities relating to groundwater remediation, an endangered species survey shall be conducted to ascertain the presence of the endangered perennial herb, the *Schwalbea Americana*, common name American Chaffseed, and if present, determine the remediation's potential to affect the endangered perennial herb.

<Figure>

<Figure>

11.0 THE STATUTORY DETERMINATIONS

Based upon available information, the selected remedy satisfies the remedy selection requirements under CERCLA, as amended by SARA, and the NCP. The remedy provides protection of public health and the environment, is cost-effective, utilizes permanent solutions to the maximum extent practicable, and satisfies the statutory preference for remedies involving treatment technologies.

Protection of Human Health and the Environment

The selected remedy will permanently treat the groundwater and remove the current and potential risk associated with the contamination. Dermal, ingestion, and inhalation contact with Site contaminants would be eliminated.

Compliance with ARARs

The selected remedy will comply with all Federal and State ARARs. No waivers of State or Federal requirements are anticipated for OU3.

Cost Effectiveness

The selected groundwater remedy is more cost-effective than the other acceptable alternatives considered. The selected remedy provides greater benefit for the cost because they permanently treat the waste.

Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment can be practicably utilized for this action. Of the alternatives that are protective of human health and the environment and comply with ARARs, EPA and the State have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost, State and community acceptance, and the statutory preference for treatment as a principal element.

Preference for Treatment as a Principle Element

The preference for treatment is satisfied by the use of a series of treatment technologies on the contaminated groundwater. The principal threats at OU3 will be mitigated by use of these treatment technologies.

APPENDIX A TO THE RECORD OF DECISION

SEPTEMBER 1993

RESPONSIVENESS SUMMARY

ABERDEEN PESTICIDE DUMPS SITE

OPERABLE UNIT 3

ABERDEEN, MOORE COUNTY, NORTH CAROLINA

This Responsiveness Summary for Operable Unit 3 (OU3) of the Aberdeen Pesticide Dumps Site (hereinafter referred to as "the Site") is divided into the following sections:

SECTION I OVERVIEW

The overview summarizes the public's reaction to the remedial alternatives listed in the Superfund Proposed Plan Fact Sheet. This plan outlines the various methods of remediation at the Site and discusses EPA's preferred alternative.

SECTION II BACKGROUND ON COMMUNITY INVOLVEMENT

The background section summarizes the major community concerns identified in the Community Relations Plan and during the public comment period on the Remedial Investigation/Feasibility Study (RI/FS) and Proposed Plan Fact Sheet.

SECTION III SUMMARY OF COMMENTS AND QUESTIONS RECEIVED DURING THE PUBLIC MEETING AND EPA'S RESPONSES

This section summarizes and responds to major issues and concerns raised by individual citizens, citizens groups, local officials, and Potentially Responsible Parties (PRPs) during the public meeting. The comments/questions and EPA's responses are categorized by topic.

SECTION IV SUMMARY OF COMMENTS AND QUESTIONS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND EPA'S RESPONSES

This section responds to all significant comments and concerns received in writing by EPA during the public comment period. The comments/questions and EPA's responses are categorized by topic.

I. OVERVIEW

The Superfund Proposed Plan Fact Sheet for OU3 of the Site was issued in May 1993. EPA's public comment period was originally scheduled to run from May 11, 1993 through June 10, 1993. This comment period was extended an additional 30 days in response to a request for an extension. EPA conducted a public meeting on May 25, 1993 to present the Proposed Plan Fact Sheet to the public for OU3. At this meeting, the public was given an opportunity to ask questions and to comment on the remedial alternatives outlined in the Proposed Plan Fact Sheet and the results of the RI conducted at OU3. The comments and EPA's responses are summarized in Section III of this document. Written comments submitted to EPA during the 60-day public comment period and EPA's responses are summarized in Section IV of this document. In general, the public did not exhibit a strong commitment to any of the alternatives presented. The two principal items of concern to the public were the lack of testing for dioxins and furans and determining the origin of contamination in the Town of Aberdeen municipal water supply wells. The PRP's principal concern was that the pump-and-treat approach to groundwater remediation would not accomplish the established goals within the predicted time frame. They proposed that alternative remediation levels be set and that the pump-and-treat scenario be carried out for a 5 to 10 year period followed by institutional controls.

II. BACKGROUND ON COMMUNITY INVOLVEMENT

The Site consists of five geographically separate areas located in and near Aberdeen, North

Carolina. Contaminated groundwater at three of these areas were investigated under this RI/FS and are summarized as follows:

- The Farm Chemicals Area is located on N.C. Highway 5 west of Aberdeen. It is approximately 600 feet upgradient of Pages Lake which is fed by Aberdeen Creek. There are commercial properties and light businesses to the south and west. Residential properties are located to the east of the Area. The closest resident lives about 250 feet downgradient and approximately 1000 persons live within a one mile radius. The Farm Chemicals Area consists of an abandoned chemical blending facility with approximately 19 structures. The facility was operated by three different companies from the mid 1930's through 1987. Some of the chemicals used at this location included sulfur, dichlorodiphenyltrichloroethane (DDT), toxaphene, parathion, aldrin, benzene hexachloride (BHC), chlordane, dieldrin, endrin, and malathion. Buried wastes include empty bags and containers, spill cleanup materials and bags of off-specification pesticides.
- The Twin Sites Area lies on the western corporate limits of Aberdeen and is on the opposite side of Highway 5 from the Farm Chemicals Area. The nearest residents are about 350 feet from the Area. More than 1000 persons live within a one mile radius. The Area slopes moderately to the north-northeast towards Pages Lake. Three locations were used for disposal (Areas A, B, and C). Area A is about 2 acres in size, Area B is approximately 0.6 acres, and the dimensions of Area C have not been completely defined as the wastes are buried as opposed to Areas A and B which are open pits. The Twin Sites Area was used from 1945 to 1971 to dispose of pesticide wastes in bags and other containers, as well as waste water containing liquid pesticides. Significant concentrations of DDT and BHC have been found in this area, as well as lesser quantities of metals, volatile organic compounds (VOCs), and other pesticides.
- The Fairway Six Area is approximately 1.6 miles west-northwest of Aberdeen off Highway 5. It is located in a rural area in terrain which gently slopes to the northeast towards the Pit Golf Links golf course lake. Pesticides were transported to this area and disposed of in a field approximately 1 acre in size from 1950 to 1972. The property was sold to a developer in 1972, who later built the Pit Golf Links golf course. There are six excavated trenches, a soil stockpile, and surface contamination containing DDT, DDD, toxaphene, and lindane.

Many citizens living around the Site had been aware of the pesticide contamination at the Site prior to the North Carolina Department of Environment, Health & Natural Resources investigation of the Areas in 1984. EPA's involvement with the Site began in 1985 with the initial removal response action at three Areas of the Site. The Site was proposed for the National Priorities List (NPL) in January 1987 and became final on the List in March of 1989. Since that time, EPA has implemented a community relations program in the Site area designed to inform the public of Site activities and solicit input from the community regarding its Site-related concerns and questions. These efforts have included: interviews with local residents and elected officials, disseminating printed public information materials, and conducting public meetings and information sessions to coincide with technical milestones at the Site.

EPA conducted community interviews with residents to identify community issues and concerns regarding the Site. Interviews revealed that citizens were concerned about their drinking water, health effects of pesticides, contamination of Pages Lake, the economic effect of the area due to the Superfund site, and disposal/treatment methods for the contaminated soil and water.

The Moore County League of Women Voters sponsored public meetings for discussion/education about the Site and Superfund activities concerning it. Local newspapers have carried numerous articles about the Superfund process at the Site.

A public meeting was held in May 1991 to present the Proposed Plan and discuss soil remediation at all five areas for Operable Unit 1 (OU1) and the stockpile of contaminated soil at the

Fairway Six Area for Operable Unit Four (OU4, formerly OU2). A Record of Decision (ROD) was signed in September 1991 for OU1. A ROD signed for OU4 in June 1989, was amended and combined with OU1 in September 1991. In December 1992, an Explanation of Significant Differences (ESD) was issued which provided information on activities and/or modified activities that were not detailed in the ROD for OU1 and Amended ROD for OU4.

As part of the Superfund program, EPA provides communities affected by a Superfund site with the opportunity to apply for a Technical Assistance Grant (TAG). This grant was awarded to MooreFORCE, Inc. in 1992 and has enabled the group to hire a technical advisor or consultant to assist them in interpreting or commenting on Site findings and proposed remedial action plans.

Based on the attendance at the public meetings and the overall feedback EPA has received from the public, the level of community interest in the Site is characterized as moderate. In general, residents have responded favorably to site remediation.

III. SUMMARY OF COMMENTS AND QUESTIONS RECEIVED DURING THE PUBLIC MEETING AND EPA'S RESPONSES

This section contains a summary of verbal questions and comments received from the community during the May 25, 1993 public meeting. Comments presented in this section are organized into the following categories:

- A. Remedial Investigation
- B. Risk Assessment
- C. Remedial Alternatives Selection
- D. Contamination of Town Wells
- E. Other Concerns

A. Remedial Investigation

Comment: A concerned citizen inquired as to how the aquifer characteristics can be determined with only two monitoring wells. Is it possible for contamination to be detected in the drinking water supply somewhere in Pinehurst?

EPA Response: Five wells were installed at the Twin Sites Area and six at the Farm Chemicals Area. All eleven wells were sampled.

The U.S. Geological Survey (USGS) has conducted some regional studies that supplement the information and data collected during this RI. These combined studies show that the Aberdeen Creek and Pages Lake are regional discharge points for groundwater flowing from a very large area on either side of the creek and lake. All of these Areas are fairly close to Aberdeen Creek or Pages Lake. The contaminated groundwater, as a result of these various pesticide dumping Areas, is only migrating a short distance and is discharging into either the lake, creek, or tributaries to the creek. Aquifer testing was limited since the regional flow system is well-defined here.

An aquifer test is performed on one or more wells and the response to pumping water out of those wells is measured in a series of wells by monitoring changes in water levels. These wells are located around the perimeter of the pumping wells. This information provides data on the characteristics of the aquifer to transmit and store water. The data collected from the surrounding observation wells is as critical as the wells which are being pumped for the aquifer test. The water level drawdown and the drop in the water level are monitored at the pumping and observation wells over time. When these measurements are plotted on a curve versus time (drawdown curve), characteristics about the aquifer can be inferred from looking at the shape of that curve. More aquifer tests are required with a large, complicated site than with a small site where the geology and flow system are well-known.

Comment: A concerned citizen noted that frequently with pesticide production processes, there are unwanted byproducts such as dioxins and furans produced, which may have carcinogenic effects as well as effects on the immune system. Has there been any testing for furans or dioxins or other chemicals associated with the production or breakdown of chlorinated

pesticides?

EPA Response: Dioxins or furans were not tested for as they were not identified as a concern when the Site investigative plan was developed in 1988. Historical site operations were evaluated and contaminants associated with these processes were identified. Dioxin or furans were not identified at that time.

Comment: A concerned citizen wanted to know if it had been determined whether there was more than one aquifer beneath the sites, as some locations in the county have an upper unconfined aquifer and a lower semi-confined aquifer and there is some migration between the two.

EPA Response: There is more than one aquifer present beneath the areas, however, the direction of flow for the groundwater from these aquifers is upward into the Aberdeen Creek/Pages Lake surface water system. This surface water system is a regional discharge point for the upper aquifers. For deeper aquifers, the regional discharge point might be much further away, but they are protected by several layers of aquifer systems and inter-aquifer layers that don't readily transmit groundwater. EPA is confident that there is no groundwater flow or contamination of any consequences moving underneath the lake or into a lower aquifer. It is all discharging into Pages Lake or Aberdeen Creek.

Comment: A concerned citizen wanted clarification of the difference between the terms "groundwater" and "aquifer".

EPA Response: The aquifer is the material that the groundwater is flowing through. The aquifer in this area is granular material, primarily sand. The groundwater is within the aquifer material and fills all the pores, beginning at the water table and continuing downward. Groundwater flows through the aquifer.

Comment: A concerned citizen requested an explanation of "how water moves uphill."

EPA Response: Groundwater, which may be a considerable distance from Aberdeen Creek is at a higher level and is causing the local groundwater to act as if it is under pressure and therefore is being forced in an upward direction.

B. Risk Assessment

Comment: A concerned citizen noted that there were 55 chemicals tested and found and about 14 of those seem to exceed the Maximum Contaminant Level (MCL). Did the risk assessment take into account the synergistic effects of these chemicals?

EPA Response: The risk posed by the various chemicals are additive. It is EPA's approach to take this into account. The actual data available on synergistic effects is very limited, therefore the mechanisms by which we get synergism between various carcinogens is not fully understood. However, in the risk assessment, adding the risk together from various chemicals to the exposure of these chemicals does constitute an approach to dealing with these synergistic effects. When remediation levels are established, they are based at 1×10^{-6} , which is the conservative end of the risk range. This allows a level of protection to account for the degree of uncertainty related to synergism.

Comment: A concerned citizen asked how many people or households are actually exposed to the calculated cancer risk associated with the ingestion of groundwater.

EPA Response: EPA does not believe that there are any people or households drinking the water contaminated by the subject areas. All residents in that area receive water supplied by the Town of Aberdeen. The risk assessment is very conservative, evaluating not only the current situation but the future possible scenario. The worst possible situation is a resident building a home on this property and installing a well for drinking water. Therefore, the calculated risk is for this future residential scenario.

Comment: A concerned citizen asked what the non-carcinogenic hazards were.

EPA Response: EPA uses a Hazard Index (HI) approach to determine if non-carcinogenic health effects are expected. A HI greater than 1 means that non-carcinogenic effects are possible. The risk assessment concluded that, based on future residential land use assumptions, the HI exceeds 1 for both the Farm Chemicals and Twin Sites Areas, but is less than 1 for the Fairway Six Area. Thus, non-carcinogenic future effects are considered possible in the Farm Chemicals and Twin Sites Areas, but are not expected in the Fairway Six Area.

C. Remedial Alternatives Selection

Comment: A concerned citizen wanted to know why the no action alternative would cost \$342,000.

EPA Response: CERCLA requires that "action alternatives" be compared to a "no action" alternative. A no action alternative is required as a baseline. CERCLA also requires that if hazardous substances, pollutants or contaminants are left on-site, affected media must be monitored every five years. For a period of 30 years, the cost of this monitoring is estimated to be \$342,000. However, should hazardous substances, pollutants or contaminants remain on-site, the five year review would not necessarily be limited to 30 years.

Comment: A concerned citizen asked if the off-gases from the air stripping requiring treatment was due to the high level of volatile organics or just a policy decision on this Site.

EPA Response: North Carolina has emissions criteria which must be met. Data shows that the expected emissions from the air stripper may be close to this criteria, so to be conservative, off-gases will be treated.

Comment: A concerned citizen inquired more about the alternatives which were considered but eliminated because they were innovative technologies, even though they would have the potential for lowering the total toxicity of contaminants, not just at the Site but in terms of the final residues. The cost of performing a treatability study is not that bad.

Were any calculations done regarding the cost of the treatability study and the time it may take, so that it is possible to determine if these are serious barriers?

EPA Response: The UV/peroxide/ozone system is an example of an innovative process which was considered and which would have modified the chemical nature of the contaminants. Although the cost was comparable and the technology appropriate, it would have required a treatability study as it is an innovative technology under development. This would have delayed implementation of the remediation of this Area.

Appendix B of the Feasibility Study does provide a cost breakdown of the options considered. These breakdowns include line items for treatability studies.

Comment: The same concerned citizen asked how long a treatability study would take for this operable unit.

EPA Response: A treatability study would probably take 6-8 months because there needs to be a lot of design and thought that goes into it.

D. Contamination of Town Wells

Comment: A concerned citizen inquired as to where the groundwater that feeds the town wells originates. Is it coming from the same aquifer that flows into the lake?

EPA Response: The groundwater flowing into those wells is from the same aquifer but it is coming from a different direction than from the contaminated areas of OU3. The town wells are on the east side of Pages Lake and Aberdeen Creek and the flow direction from either side of the

stream is toward the stream. The town wells may disrupt the natural flow to a certain extent, but it is certain that they are not drawing contaminants from under the stream. There is not enough disturbance to the natural flow system for that to be occurring. A detailed study performed by the USGS supports this conclusion.

Comment: A concerned citizen wanted to know if EPA knew where the contamination in the town wells was originating.

EPA Response: The origin of contamination in the town wells is not clear at this time, however, EPA is confident that OU3 is not the source of the contamination in town wells 1, 2, and 4.

Comment: A concerned citizen wanted to know if the drinking water is contaminated or will it become contaminated. Is anyone drinking water contaminated by these sites? Could the town water become contaminated?

EPA Response: The water that is associated with OU3 is contaminated. Most residents are on town water. EPA is unaware of anyone in the vicinity of OU3 who is drinking the contaminated water from these areas.

At least three of the town wells have been closed due to groundwater contamination. They contain contaminant levels which exceed the criteria that EPA will allow for a drinking water supply. The remaining wells are being closely monitored by State and local officials. There is always a possibility of these wells becoming contaminated, however, it would not be due to OU3.

Comment: A concerned citizen asked that if Ciba-Geigy isn't contaminating the town wells and if the areas under investigation discussed here aren't contaminating the wells, then what is?

EPA Response: To date it has not been determined what contaminated the town wells however, the EPA feels confident it is not OU3, as shown by the data collected during the RI.

Comment: A concerned citizen wanted to know if the EPA will actively seek out the source of the contamination of the town wells.

EPA Response: EPA's investigation concluded that OU3 did not impact the town wells. EPA could not identify the source of contamination under its CERCLA jurisdiction, where such investigation is limited to sites on the National Priorities List. However, the State interjected its continuing jurisdiction and involvement in addressing this concern.

Comment: Another concerned citizen stated that "all the work you are doing will not make our wells safe then?"

EPA Response: Not all of the town drinking water wells are contaminated. The investigation of the Site addressed groundwater suspected to be contaminated from the activities previously ongoing at the Site Areas.

Comment: A concerned citizen asked who will be responsible for investigating the contamination of the town wells.

EPA Response: There are a number of programs in place to protect public drinking water supplies. The Safe Drinking Water Act requires that all public water supplies be routinely tested. The State of North Carolina has an Inactive Sites Group which is responsible for sites that haven't ranked on the NPL and for performing preliminary assessments. State officials present at the public meeting assured everyone present that under its authority, the source of contamination to the Town of Aberdeen municipal water supply wells is being sought.

E. Other Concerns

Comment: The current president of MooreFORCE, Inc. asked for a 30-day extension of the comment period.

EPA Response: This request was granted.

Comment: A concerned citizen wanted to know if the state is still paying ten percent of the clean up for soil and groundwater or have the PRPs reached an agreement to perform the work.

EPA Response: To date there has been no need for the State to contribute financially to the Site cleanup.

Regarding OU3, no agreements have been reached for groundwater remediation. Following issuance of this ROD, the responsible parties will be notified and given an opportunity to submit a good faith offer to complete the work. EPA does not anticipate reaching this point until the fall of 1993.

With regard to remediation of contaminated soil for OU1 and OU4, EPA issued Unilateral Administrative Orders in May 1993, to 22 responsible parties. The Order compels the responsible parties to perform the work outlined in the ROD for OU1 and Amended ROD for OU4. Eleven parties have responded to EPA's Order and will implement the ROD/Amended ROD. Since the responsible parties will finance the cleanup of contaminated soil, the State will not have to contribute financially.

Comment: A concerned citizen noted that the Areas remain open and accessible to the public. Shouldn't the Areas be posted, fenced, and sealed off from the public?

EPA Response: EPA has written into their recently issued order that the responsible parties, should they comply, must secure the Areas with fencing and sign posting within five days of their notice of intent to comply with the order. EPA will implement these institutional controls if the responsible parties do not comply with the order.

Comment: A concerned citizen wanted to know if their water supply could or was contaminated as a result of the abandoned pesticide facility located on Route 211, the Geigy Chemical Superfund Site.

EPA Response: An investigation was conducted by the responsible parties for the Geigy Chemical Superfund Site to identify the extent of groundwater contamination. A Record of Decision addressing contaminated groundwater was signed in August 1992. A Consent Decree, entered in court on July 15, 1993, allows the responsible party to further define the extent of groundwater contamination and implement a pump-and-treat system to remediate the groundwater emanating from that Site.

IV. SUMMARY OF COMMENTS AND QUESTIONS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND EPA'S RESPONSES

This section contains a summary of the written comments received during the 60-day public comment period from May 11, 1993 through July 10, 1993. Comments presented in this section are organized into the following categories:

- A. Comments from the Ad Hoc Aberdeen PRP Group prepared by Dames and Moore, Inc.
- B. Comments from the TAG recipient, MooreFORCE, Inc., prepared by Environmental Compliance Organization (ECO)
- C. Comments from Olin Corporation prepared by Rust Environment and Infrastructure
- D. Comments from other interested parties

A. Comments from the Ad Hoc Aberdeen PRP Group prepared by Dames & Moore, Inc.

Section 2.0 Proposed Alternative Remediation Plan

Comment: Cleanup goals should be identified as Alternative Concentration Limits (ACLs) based on

the point of efficient removal of chemicals from the aquifer and, determined through continuous monitoring of the proposed pump-and-treat operation.

EPA Response: Performance Standards must be set at levels which are conservative and sufficient to protect human health and the environment. There has been no demonstration that the conditions required for an alternate concentration limit apply to OU3. Furthermore, based upon CERCLA [Para] 121(d)(B)(ii)(II), CERCLA ACLs would be inappropriate for the Twin Sites Area, and probably the Farm Chemicals and Fairway Six Areas, because site-related contaminants have been detected in downslope or downgradient surface waters.

EPA's OSWER Directive 9283.1-03 addresses the effectiveness of pump-and-treat based on an evaluation of nineteen operating groundwater extraction systems. This guidance recommends ROD language which considers low uncertainty that the remedy will be able to achieve the performance standards through the area of attainment. This ROD includes language in the Decision Summary which allows for a re-evaluation of the performance standards and/or the remedy following careful monitoring of the system's performance.

Comment: Establish institutional controls, including deed restrictions, to protect against groundwater use in the vicinity of the plume.

EPA Response: The use of institutional controls may be appropriate at some point in the future and will be retained for further consideration; however, according to the North Carolina Drinking Water and Groundwater Standards, North Carolina Administrative Code (NCAC) Title 15A, Subchapter 2L, Section .0103(b), the state protects all aquifers as suitable for drinking water purposes, thus implementing institutional controls to prevent its use as a future water source is inappropriate. Moreover, based on OSWER Directive 9283.1-03 cited above, the remedy and/or performance standards may be re-evaluated in which case institutional controls may be determined to be an effective remedy component.

Comment: Even under the most favorable conditions conceivable, the proposed remediation target levels (Table 3-4, FS Report) cannot be achieved through pump-and-treat.

EPA Response: The PRPs' analysis of a groundwater pump-and-treat remedial action (summarized in Section 8 of the Ad Hoc Group comments) considers the potential times required to reduce the maximum or near-maximum groundwater concentrations of specific chemicals to their target clean up levels. This ignores the fact that most of the OU3 groundwater contamination contain the selected contaminants in concentrations well below the maximum detected concentrations. Thus, the attainment of target groundwater concentrations for most contaminants of concern, over most of OU3, may occur within a reasonable time frame.

Localized areas of especially high groundwater contamination may be difficult to remediate to targeted remedial goals within acceptable time frames. However, the groundwater remedial action may nonetheless reduce some groundwater concentrations to below the high end of the acceptable risk range (less than 10⁻⁴ carcinogenic risk) within a reasonable time frame. Thus, while the EPA's specified non-MCL groundwater performance standards may be desirable to attain (for example, the ROD's specified DDT performance standard of 0.025 ug/L), a lesser degree of groundwater DDT remediation will certainly be attainable through pump-and-treat. Reduction of groundwater concentrations to below the high (risk) end of the acceptable risk range, or a substantial reduction of the risks associated with contact with contaminated groundwater, would certainly be a justification for pump-and-treat remedial action.

Section 3.0 Absence of Groundwater Risk Pathway

Comment(3.1): Groundwater within the vicinity of the Area plumes is not utilized for drinking water and would be unfit for human consumption even if all chemicals associated with the Site were removed. Use of the groundwater as a water supply source is improbable due to its existing poor upgradient quality. Drinking water for the area surrounding and including the Farm Chemicals/Twin Sites Areas is supplied by the Town of Aberdeen. Therefore, the need to utilize the groundwater in the vicinity of the Areas as a present or future source of drinking water is improbable.

EPA Response: Although in many areas, groundwater concentrations of some metals such as iron and manganese would probably be objectionable because of aesthetic factors, these high metals concentrations may actually be indirectly related to Area contamination. There is an obvious upgradient source of tetrachloroethene near the Farm Chemicals/Twin Sites Areas. However, not all wells at these Areas are contaminated with the compound or its degradation products.

Because there are no known existing ordinances, deed restrictions, etc. preventing future groundwater consumption, evaluating a future groundwater use exposure pathway is reasonable. Further, although no residents currently live and/or drink groundwater at the Fairway Six Area, a portion of this Area is privately owned by a developer and is likely to undergo future residential development.

Comment(3.2): Groundwater from the Areas does not pose a threat to uncontaminated deeper groundwater sources or uncontaminated down gradient groundwater in the shallow aquifer zones.

EPA Response: Because of the hydrogeologic setting of the Farm Chemicals, Twin Sites and Fairway Six Areas, groundwater contamination is restricted to the uppermost aquifer. However, in some areas downgradient of the Twin Sites Area and Fairway Six Area, there is a potential for currently uncontaminated shallow groundwater to become contaminated in the future, because of continued plume expansion. Therefore, the selected groundwater remedial action alternative has the additional benefit of preventing the expansion of any contaminant plumes into presently uncontaminated areas.

Comment(3.3): It is apparent, that the contamination detected in the groundwater seep sediments and Pages Lake is related to transport of contaminants via surface water runoff to these areas.

EPA Response: For most pesticides, at most sampling stations, it is correct that pesticide concentrations in seep areas could not have resulted from groundwater discharges. However, at least some of the pesticides in sediment in the seep areas are derived from groundwater discharge. The contribution of pesticides to seep sediments from groundwater discharge alone may be a significant problem.

Section 4.0 Review of the Baseline Risk Assessment

Comment(4.2): Exposure to groundwater was not considered to be a completed exposure pathway at Farm Chemicals, Twin Sites or Fairway Six Areas under current land use conditions. Future land use scenarios ignores a number of site conditions which would make future consumption of groundwater unlikely.

EPA Response: At the time of the RI field investigation, an employee of Farm Chemicals was living at the Farm Chemicals Area or at least spending a few nights a week there. Thus, the on-site residential scenario was evaluated under current land use at the Farm Chemicals Area. There was no indication of groundwater use at the Twin Sites or Fairway Six Areas during the time that the RI/FS documents were developed, thus the on-site residential scenario was not evaluated under current land use at these Areas. Based on EPA's Risk Assessment Guidance (Dec. 1989a), it was determined that an evaluation of risk under future exposure scenarios were appropriate for OU3.

Upgradient contamination is not listed as a criteria for omission of a plausible future scenario according to guidance EPA/540/1-89/002. The probability of realization of the future scenario may be low, however, the risks associated exposure is high, as evident in Tables 2-22, 2-23, and 2-24A of the FS Report.

Comment(4.3): Because groundwater data were collected over a number of sampling events, it was difficult to assess if the exposure concentrations selected for the Baseline Risk Assessment were actually representative of site conditions.

EPA Response: EPA's approach to determining exposure point concentrations is well detailed in

appropriate guidance documents (EPA/540/1-89/002 and Publication 9285.081). The Aberdeen Risk Assessment was developed in accordance with applicable guidance, thereby using the lower of the 95% upper confidence limit on the mean or the maximum detected concentration.

In addition, the April 15, 1991 Supplemental RI Data Analysis Report, Addendum to Risk Assessment, calculated the chronic lifetime excess cancer rate (LECR) for a future on-site adult resident at the Farm Chemicals Area. The assessment for this Area utilized a DBCP exposure concentration of 140 ug/l which resulted in a total LECR of 7.3×10^{-2} .

Comment(4.4): The rationale used for selection of the Remedial Action Objectives (RAO) found on Table 3-4 of the FS Report is unclear for a number of the chemicals. For example, the Remedial Action Objective chosen for alpha- and beta-BHC are reported to be their respective Federal MCLs (1 ug/L); however, no MCL could be found for either chemical.

EPA Response: In the case of the RAO for alpha- and beta-BHC, an error was made in that there is no MCL for these two contaminants of concern. EPA agrees that the basis for the RAOs for some of the contaminants of concern is unclear. Some of the confusion may lie in the fact that some of the risk based RAOs were calculated and documented in the May 1, 1991 Draft Final Feasibility Study Report, for OU1 of the Site. The rationale for the performance standards outlined in this ROD include Federal and State groundwater standards, and an EPA action level.

Comment(4.5): In Table 2-24A of the FS, quantitative estimates of risk have been present for a number of exposure pathways at the Fairway Six Area, including groundwater; however, Table 2-20 of the FS Report lists the estimated exposure frequency to groundwater as 0 days or events per year.

Risks from exposure to groundwater at the Fairway Six Area were calculated by EPA using analytical data from a single well located on the Yadco Property. A number of discrepancies in the calculations, combined with limited data from a single well, make interpretation of the results difficult.

EPA Response: EPA acknowledges the discrepancy between Table 2-20 and 2-24A of the FS Report. The 0 days or events/year reflected for the Fairway Six Area represent the current exposure from ingestion of contaminated groundwater. Since no one currently consumes groundwater at the Area, the exposure frequency is nil. Exposure frequency assumptions utilized for the Fairway Six Area future residential scenario risk assessment, are discussed in the May 8, 1991 memorandum from Solomon Pollard to Kay Crane.

Assumptions used in calculating risks at the Fairway Six Area are provided in the Administrative Record and are standard exposure factors. Note however, that the assumptions utilized were based on available assumptions and practices at the time of the document's construction. EPA does not find any discrepancies in the calculations overall.

Comment

(Appendix B.1): Procedures for calculating risk-based preliminary remediation goals have been developed for specific environmental media, including groundwater (EPA, 1991). These procedures use standard EPA default exposure values and risk equations developed for the residential use of groundwater. We have examined a number of those chemicals listed in the FS which do not have federal or North Carolina drinking water standards or North Carolina water quality standards for groundwater. Chemicals for which the proposed remedial levels appear to be inconsistent with current guidance are listed below.

EPA Response: While it is true that "Risk Assessment approach" have evolved over the past 4 years, the guidance-based approaches employed in the Aberdeen risk characterization were appropriate. The EPA, 1991 guidance was completed in December (1991) which was after the completion of most site documents, specifically the risk assessment. The guidance document quoted by the commentor is used in developing preliminary remediation goals and not remedial action objectives. The risk assessment process is dynamic and historically inhalation was usually not considered in developing cleanup goals.

Comment

(Appendix B.2.1): In the Supplemental RI Data Analysis Report Addendum to the Risk Assessment (CDM, 1991), the cancer risks for DBCP are calculated using $22 \text{ (mg/kg/day)}[-1]$ to represent both the oral and inhalation cancer slope factors (SFs). Subsequent evaluation of this compound by EPA has resulted in a reduction of the SF and the publishing of separate SFs for the two exposure routes. The new oral SF is $1.4 \text{ (mg/kg/day)}[-1]$ and the new inhalation SF is $2.4 \times 10[-3] \text{ (mg/kg/day)}[-1]$ (HEAST, 1992). This reduction in the SFs would cause the lifetime excess cancer risks (LECRs) for the oral and dermal DBCP exposure pathways in the risk assessment to be almost 16-fold lower; the LECRs calculated for the DBCP inhalation exposure pathways would be approximately 9,000-fold lower.

EPA Response: EPA used appropriate existing toxicity data at the time of the risk assessment development. The most current source of toxicity data (IRIS) indicates that the oral slope value for DBCP has been withdrawn and is under review as of July 1, 1992. Further, according to HEAST, 1993, the new inhalation FS is $6.9 \times 10[-7]$. New knowledge in contaminant toxicity probably should be considered in setting performance standards. However, DBCP's toxicity rating is still under review. Thus the described changes are not appropriate.

Comment

(Appendix B.2.2): The EPA RfD/RfC Work Group recently reported that the chronic inhalation RfC for xylene (mixture) was considered "not verifiable" (HEAST, 1992).

EPA Response: According to IRIS, all toxicity values for xylene have been withdrawn. Alteration of performance standards based on currently unavailable toxicity values is not compatible with EPA's mandate of protection of human health and the environment.

Comment

(Appendix B.3): The estimates of risk to human health, summarized in the 1993 FS Report, are very conservative and will tend to overestimate actual site risks. A number of "default" exposure parameters were integrated into the risk assessment. Again, the use of default exposure values rather than site-specific exposure values results in an extremely-conservative risk assessment, which probably overestimates actual site risks.

EPA Response: The changes proposed herein will not significantly impact the outcome of the risk assessment and are not recommended. The reduction in the three denominator items (averaging time, body weight, and exposure frequency) will serve to increase the calculated risk while the balance of suggested numerator changes will serve to decrease the risk.

Comment

(Appendix B.4): Calculation of the LECR for dermal exposure of a child to groundwater while showering resulted in a value of $1.8 \times 10[-3]$. When we recalculated this value using the same exposure assumptions, the cumulative LECR for dermal absorption was $4 \times 10[-8]$.

EPA Response: EPA acknowledges that there is an error in the calculation and the corrected risk due to showering for a child is $4.7 \times 10[-8]$. However, it is noted that the cumulative risk from all routes remains unacceptable for an adult resident ($1.1 \times 10[-3]$).

Section 5.0 Assessment of Adequacy of the Available Data

Comment(5.2): A detailed knowledge of the stratigraphy, including the size and orientation of preferred migration pathways and impediments to groundwater flow, needs to be developed in order to allow an estimation of the practicality of recovery, as well as the design and effectiveness of extraction wells.

EPA Response: EPA believes that the stratigraphy of the investigation areas has been defined in adequate detail to support a groundwater pump-and-treat remedial action. Specific aquifer properties and localized stratigraphy which should be considered in the design of extraction wells can be further identified during the Remedial Design phase or, if necessary, during the construction of individual extraction wells.

Comment(5.2): All the additional sampling activities must be conducted in a manner consistent with the integrity of the confining layers. Available records indicate that installation of certain wells were performed without considering the integrity of the underlying clay layers. To prevent downward migration of chemicals of concern, precautions must be made to avoid such field practices.

EPA Response: EPA agrees that precautions must be made to avoid practices which would jeopardize the integrity of underlying clay layers. In no case did EPA during the RI construct wells which would allow inter aquifer contamination. Although the RI contractor did penetrate a confining clay layer, they did not penetrate completely through the clay confining unit. However, due to the upward hydraulic gradient across the confining unit (see USGS report, "Hydrogeology and simulation of ground-water flow in aquifers at the Aberdeen superfund sites, North Carolina," Figure 35), it is improbable that well construction has jeopardized the confining unit.

The installation of a deep temporary well (T01) in November 1992 at the Fairway Six Area did not breach a confining clay layer. Consequently, pressure grouting from the bottom of the well up was not required. Standard EPA practice is to pressure grout the borehole if a confining layer is breached.

Comment(5.3): The assumption of high transmissivities and homogeneous conditions is not supported by any site-specific data. Further, it is extremely nonconservative for estimating the efficiency and applicability of a groundwater extraction system to achieve cleanup goals. Selection of such unsubstantiated optimistic parameters for conceptual design when data is limited is not standard or appropriate engineering practice. Additional information on flow rates at the Areas needs to be collected before the extraction system proposed in the FS Report is determined to be a practical remediation alternative.

EPA Response: EPA acknowledges that there is some variation in the aquifer properties within the Areas of investigation. However, EPA believes that its estimates of the average aquifer properties are reasonable, given the combination of site-specific and regional hydrogeologic data which are available.

Several studies within this region (Giese and others, 1991, and Moore, Gardner, and Associates, 1972) report aquifer transmissivities of greater than 1000 ft²/day for the combined upper and lower Black Creek aquifers. EPA considered these regional transmissivity values, the site-specific stratigraphy for the water table aquifer (lower Black Creek aquifer) observed during the RI, and the Farm Chemicals and Twin Sites Areas RI aquifer test data to support the estimate of the average aquifer transmissivity for the Farm Chemicals/ Twin Sites Areas. EPA believes that this approach is justified.

EPA estimates a lower transmissivity for the Fairway Six Area, relative to the transmissivity estimate for the Farm Chemicals/Twin Sites Areas. This lower transmissivity estimate is indicated by both site-specific aquifer test data and stratigraphic information. Again, for the Fairway Six Area, EPA believes it is justified in basing its estimate of the average transmissivity not only on EPA's interpretation of site-specific aquifer test data but also on the site-specific stratigraphy and on the regional aquifer transmissivity estimates cited in the USGS report.

Comment(5.4): The current delineation of chemical plumes, as presented in the FS Report, is based solely upon a limited number of monitoring wells. Furthermore, no significant information is available on the vertical chemical distribution which leaves a serious gap in the available data. The current lack of accurate concentration data precludes selection of a remedial alternative which can demonstrably achieve the stated cleanup goals within a reasonable period of time.

EPA Response: The EPA is confident that enough data are available to screen and evaluate alternatives against the nine criteria, which are appropriate for remediating the Site. EPA believes that because the saturated thickness of the water-table aquifer is relatively thin at the Farm Chemicals and Twin Sites Areas, this potential vertical spreading of contaminant

plumes, outside of the contaminant source areas, is probably insignificant. Vertical contaminant zonation in the source areas has been acknowledge to be potentially significant by EPA, and will duly be considered during remedial design. While the stratigraphy at the Fairway Six Area is complex, information on the vertical contaminant distribution in this Area was obtained by EPA during the November, 1992 field investigation.

Comment(5.5): The FS Report and its supporting documents fail to consider the potential retardation of chemicals by clays, which are dispersed throughout the surficial aquifer. Instead, they have focused on the retardation mechanism controlled by organic carbon.

EPA Response: The degree of contaminant retardation is, in relative terms, defined by the groundwater contaminant distributions which have been determined by groundwater monitoring. The contaminant distributions in groundwater, and in seep samples at the Twin Sites Area, indicate that volatile organic contaminants, and themore inherently mobile pesticides such as the BHC compounds, are in fact, mobile at the Farm Chemicals, Twin Sites, and Fairway Six Areas. The implication that groundwater remediation is probably unworkable because of some undetermined clay concentration in the aquifer which will significantly impede contamination migration and groundwater remediation is not supported by the groundwater contaminant distribution patterns.

Section 6.0 Remedial Technologies Assessment

Comment: The Ad Hoc Group proposes that instead of a specific list of remedial techniques, a conceptual framework composed of a range of treatment technologies be defined in the final remedial plan.

EPA Response: The NCP requires EPA to choose an alternative which provides the best balance of tradeoffs among the nine-criteria. This ROD's Decision Summary selects a number of technologies and processes to remediate the contaminated groundwater. New information submitted to EPA which supports alternative treatment technologies may be considered by EPA and, as necessary, appropriate modifications to the remedy will be made in accordance with the NCP.

Section 7.0 Appropriate Site-Specific Remediation Objectives

Comment: The value of hydraulic containment is dictated by the potential for migration of the chemicals beyond the boundaries of OU3. Based on an evaluation of contaminant migration at the Areas, it can be stated that the main remedial objective at OU3 is groundwater cleanup, and not hydraulic containment. The selected remedial alternative should have a proven record for groundwater cleanup and not merely a system for providing hydraulic containment.

Given that hydraulic containment is not a soughtafter remedial objective, does the proposed pump-and-treat plan offer effective cleanup of groundwater contamination? Given the low solubilities of many chemicals of concern at OU3, the selected pump-and-treat plan probably will yield hydraulic containment, rather than the sought after long-term, high-efficiency groundwater cleanup. This conclusion, however, must be evaluated through a site-specific assessment of the cleanup efficiency of the proposed remedial plan.

EPA Response: As noted in an earlier EPA response, EPA has used OSWER Directive 9283.1-03, in writing the Decision Summary. This directive takes into consideration the success of pump-and-treat of contaminated groundwater and recommends appropriate language based on low or high uncertainty that the performance standards will be met. Section 10.0 of the Decision Summary describes conditions during pump-and-treat in which the selected remedy and/or performance standards may be re-evaluated.

Section 8.0 Assessment of the EPA Proposed Remedial Plan

Comment

Summary: Numerical modeling of groundwater/flow transport was performed by Dames and Moore in order to assess the effectiveness of the proposed pump-and-treat alternative and assist in establishing well locations.

Comment(8.1): The flow and transport modeling was conducted through the use of the latest version of U.S. Geological Survey's 2D-MOC. Figure A-2b shows the Fairway Six Area well configuration suggested by Dames and Moore to improve coverage and compatibility of the extraction system in response to the recent groundwater sampling results, conducted in November, 1992.

EPA Response: The proposed well configuration is based on data that was generated from a chemical transport model. The underlying flow system must be simulated by a calibrated flow model which should be consistent with a predetermined conceptual model of the aquifer systems. Given the fact that the model presented in this document uses existing site data and that the data may be inadequate to support the 2-D transport model, it does not make good engineering sense to accept this solution to the extraction well network. EPA believes the modeling performed for this FS is reasonable for cost estimating purposes and that actual extraction well/interceptor trench configuration shall be determined during Remedial Design.

During the Remedial Design, if it is determined that groundwater modeling is necessary to simulate groundwater and chemical transport, then a 3-D groundwater flow and chemical transport model will be selected. This model will have the capability of simulating both groundwater flow and chemical transport. The use of a 3-D flow and transport model is strongly recommended because chemical movement through a granular matrix is a three dimensional physical process. Because chemical movement is a three dimensional process, the simulation of groundwater flow must also be in three dimensions even though groundwater flow may be 2-D.

Following the development of a calibrated flow model, attenuation rates and estimated clean-up times will be established by integrating the chemical transport simulation with a calibrated flow simulation. In addition, if it is determined that additional hydrogeologic and/or hydraulic data are needed to better characterize Site conditions, then data collection activities will be implemented during the remedial design.

The grid used in the modeling is very uniform and does not represent the hydrogeologic features of the model area. This grid should reflect the surface water and groundwater features as well as pumping centers. It is evident that this model is a very simplified representation of a complex flow system. It is felt that although numerical techniques are used to generate the simulations presented in the Ad Hoc Group comments, they are probably no more accurate than the analytical approach used in the FS because of the model design and the selected input parameters. A calibrated flow model is essential to the development of a transport model that has any merit.

Comment(8.3): Selected model parameters were derived either from available information in the FS Report or computed under favorable conditions for pump-and-treat operations.

EPA Response: The model parameters that represent "favorable conditions" have no significance in terms of evaluating chemical movement within the underlying aquifer systems. The model should use site-specific data when available. Creating conditions is a good planning tool, however there is quality data that has been collected from the Areas that should have been used in these simulations.

The assumption that the "shallow groundwater is a perfectly homogeneous and isotropic aquifer" is not an acceptable assumption as is evident by the position taken by Dames and Moore as reflected in their comments. The model should adhere to a predetermined conceptual model and any changes to this model should be supported by site-specific hydraulic data.

Instead of using organic carbon content, it is recommended that Kd tests for indicator chemical be made in the laboratory to increase the confidence level of data generated with Kd values.

Comment(8.4): The model results has yielded a number of conclusions, which can be summarized as:

- Current EPA proposed clean-up targets are technically impracticable;

- The cost of attempting to reach MCLs would be prohibitive; and
- The appropriate standard of performance is an optimum removal of chemical mass.

EPA Response: The three conclusions stated as a result of the modeling effort are not supported by the transport modeling presented in the Ad Hoc Group comments. The modeling effort has technical deficiencies in the set-up of the model (grid of model has no hydraulic significance), a calibrated flow model of the aquifer system was not prepared prior to simulating chemical movement, fictitious data was used in the initial input, and a conceptual site model was not prepared and used to guide the selection of input parameters and to support or refute model results.

Comment

(8.4.1): All the investigated chemicals utilized in the modeling clearly indicate that attaining the assigned target levels is technically impracticable.

EPA Response: The Ad Hoc Group's model-projected groundwater remedial time frames are based upon an assumed number and placement of recovery wells that do not minimize the remedial time frames. The placement of recovery wells in the modeling, relative to the placement of assumed contaminant particles in the modeling, has a significant effect on the modeled remedial time frames. The assumed initial contaminant mass in the system (dissolved and adsorbed) also has an effect on the projected contaminant concentrations versus time. All of the modeling input data and model output discussed in Section 8 are not presented in the Ad Hoc Group report. For the data which are presented, EPA disagrees that the modeling assumptions as to the placement of contaminant mass and recovery well locations minimize the remedial time frames. Modeling which assumes the highest groundwater contaminant concentrations are several hundred feet downgradient from the nearest recovery well does not result in a predicted minimal remedial time frame.

Comment

(8.4.2): The results of the groundwater flow/transport modeling effort illustrates that the cost of pump-and-treat per unit mass of removed chemical has an increasing tendency. Even under optimistic conditions, after the first few years of pump-and-treat, the cost of recovery per unit mass of various chemicals reaches prohibitive levels.

EPA Response: The EPA acknowledges that the cost per unit mass removed should increase. However, the PRPs' conclusion that treatment costs reach "prohibitive levels" over time is based upon a subjective interpretation of the term "prohibitive levels". EPA recognizes that the cost will increase, however, EPA also believes that the selected alternative provides the best balance of trade-offs.

Comment

(8.4.5): To generate a more realistic set of model results, many model parameters had to be modified. In order to preserve the favorable condition for pump-and-treat, we decided to execute only those changes that can be supported by the available information. Targeted parameters are transmissivity and organic carbon content (foc).

EPA Response: Other changes which could be supported by the available information and which should have been, but were not considered by the PRPs in their modeling to enhance pump-and-treat were:

- a) to assume lower initial contaminant concentrations between monitoring well locations, such that less contaminant mass was initially in the system and,
- b) to change the number and placement of recovery wells to optimize the groundwater remedial time frames.

B. Comments from the TAG recipient, MooreFORCE, Inc. prepared by ECO

Comment: The site has been inadequately characterized for all Constituents of Interest (COIs). Most notably there has been no documented attempt to determine the potential and likely presence of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofuran (PCDF), commonly known as dioxin and furan. It is absolutely necessary that an immediate comprehensive sampling effort be instituted to identify and quantify the potential presence of dioxins and furans at each of the five sites.

EPA Response: The RI was conducted according to an approved work plan which did not include sampling for dioxins and furans. EPA agrees that screening of groundwater for dioxins and dibenzofurans should be considered for this operable unit. A sampling program will be implemented during the remedial design. Screening of soil for dioxins and dibenzofurans will be addressed by EPA outside of this ROD.

Comment: The calculated risk for all media does not include the possible risk from dioxin and furan and therefore may be seriously underestimated.

EPA Response: It is true that the calculated risk did not include possible risk associated with exposure to dioxins and furans because the approved analytical program did not include these analyses. If dioxins and furans are present, the lifetime excess cancer risk (LECR) will be higher; however, the LECR in each of the study areas already exceeds EPA's acceptable range for Superfund sites, so the net effect of a higher LECR would be nil.

Comment: The potential risk should be quantified for each option associated with the various remedial alternatives being considered.

EPA Response: EPA does not calculate risks associated with the various alternatives. As appropriate, and to the extent sufficient information is available, the short-and long-term aspects of effectiveness, implementability and cost shall be used to guide the development and screening of remedial alternatives. These factors are considered when selecting an alternative and specific measures to be taken to alleviate any hazards during remediation will be determined during the remedial design.

Comment: Surface water contamination has been inadequately characterized. This deficiency is exacerbated by the failure to provide PCDD/PCDF analysis of this data.

EPA Response: EPA disagrees. Sufficient samples were collected during the RI and the evaluation of surface water contamination was complete enough for the purposes of the FS and remedy selection. Given dioxin's low water solubility [7.91 ng/L (parts per trillion or ppt)] and density greater than water [1.827 g/mL (ATSDR, 1988)], it is not likely that dioxin would be detected in surface water at the Site.

Comment: The selected alternatives for OU3 fail to meet the general cleanup standards established by Superfund and the NCP especially when considering the potential for the presence of PCDD/PCDFs at the site.

EPA Response: EPA disagrees. Sufficient sampling was conducted to perform the FS and select a remedy. The preferred alternatives for OU3 satisfy the statutory requirements of CERCLA and are the most protective of human health and the environment. Sampling for dioxin and dibenzofuran in the groundwater will be conducted during the Remedial Design and the results and impacts will be evaluated at that time.

Comment: EPA's decision to not take remedial action on contamination at OU3 of the surface water and sediment violates the NCP.

EPA Response: EPA disagrees. Based on the voluminous amount of data available for OU3, the risk assessment determined minimal risks associated with the surface water and sediments at the Pages Lake.

C. Comments from Olin Corporation prepared by Rust Environment and Infrastructure

Proposed Plan

Comment: Performance standards are typically set in the ROD. No groundwater standards are provided in the proposed plan. This may be because North Carolina is about to revise their groundwater standards. However, the extent of remedial requirements should be defined before a remedy is selected.

EPA Response: The Remedial Action Objectives, which identifies applicable or relevant and appropriate requirements, are presented in Table 3-4 of the Feasibility Study Report dated May 1993. The Decision Summary of this ROD identifies the groundwater remediation performance standards in Table 22.

Comment: There is no list of the chemicals of concern. The text on page 5 mentions pesticides, VOCs and metals, but it is unclear whether all of these have to be extracted from the groundwater.

EPA Response: Contaminants of concern for OU3 are summarized in Table 3-4 of the FS Report. Page 3-19 of the Report identifies the RAOs as contaminants of concern for OU3.

Comment: For Alternatives 3A and 3B for the Farm Chemicals and Twin Sites Areas, the text says that the discharge must satisfy the NPDES permit requirements. This is only true for discharge to a surface water. Discharge to a POTW would be governed by the Moore County pretreatment agreement. Discharge to an infiltration gallery or a reinjection field would be governed by North Carolina groundwater standards.

EPA Response: The Agency agrees with the comment and the Decision Summary discusses and clarifies the various requirements for off-site discharge.

Comment: Metals treatment may require further evaluation. Chromium can only be precipitated if it is in the trivalent (+3) form. Hexavalent (+6) chromium would have to be reduced before it could be precipitated. Metals, especially copper, have very low discharge levels based on ambient water quality standards. It is unlikely that simple precipitation would be capable of meeting NPDES standards for copper.

EPA Response: The specific treatment train for metals will be established during the Remedial Design phase. The method of discharge will dictate the degree of treatment.

Comment: Antimony, chromium, copper and manganese are not typical pesticide ingredients. Background levels for these compounds should be established before remediation requirements are defined. A significant portion of groundwater treatment costs would likely be associated with metals removal. The extent and duration of groundwater extraction may be excessive if background metals are to be removed. The Proposed Plan should state that background levels for metals will be established during Remedial Design and that remediation will be required for those metals that significantly exceed background.

EPA Response: The North Carolina Drinking Water and Groundwater Standards, NCAC Title 15A, Subchapter 2L.0202(b)(3) states that where naturally occurring substances exceed the established standard, the standard will be the naturally occurring concentration as determined by the Director. EPA agrees that metals which are identified at background levels do not require remediation. An evaluation of inorganic background concentrations shall be performed during Remedial Design.

Comment: Alternative 3 for the Fairway Six Area incorrectly references Alternatives 3A and 3B for Farm Chemicals/Twin Sites Areas as being in situ permeable beds.

EPA Response: The Proposed Plan inadvertently referenced Alternatives 3A and 3B for the Farm Chemicals/Twin Sites Areas as being in situ permeable beds. The correct reference should have been to Alternative 2 for the Farm Chemicals/Twin Sites Areas.

Comment: Ultrafiltration and reverse osmosis processes do not involve treatment. They generate concentrated reject streams that require further treatment. The Proposed Plan implies that ultrafiltration and reverse osmosis are complete solutions when they are not.

EPA Comment: Although the Proposed Plan may have appeared to imply that the ultrafiltration and reverse osmosis processes involve chemical alteration of the contaminants, it is clearly understood that these processes are purely physical separations of contaminants from the groundwater media. Pages A-7 and A-8 of the FS Report provide a description of the two processes. In addition, page 4-3 of the FS Report defines the "treatment" actions evaluated in the FS Report as involving (1) removal of contaminants from the contaminated media or (2) alteration of the contaminants, making them innocuous.

Comment: EPA should leave the determination of metals removal, the need for air emissions control and other detailed issues regarding the selected remedy to Remedial Design. The ROD should allow for treatability testing and for flexibility in the selection and optimization of treatment equipment.

EPA Response: EPA's responsibility in the FS and remedy selection process is to choose an alternative which provides the best balance of tradeoffs among the nine-criteria. This ROD's Decision Summary selects a number of technologies and processes to remediate the contaminated groundwater. New information submitted to EPA which supports alternative treatment technologies may be considered by EPA and, as necessary, appropriate modifications to the remedy will be made in accordance with the NCP.

Comment: The OU3 Record of Decision should include the technical impracticability language for groundwater remediation that was given in the ROD for the Geigy Chemical Superfund Site in Aberdeen, North Carolina.

EPA Response: This ROD's Decision Summary will contain language in accordance with OSWER Directive 9283.1-03. This directive suggests language to be included in a ROD when there is low uncertainty that the remedy will be able to achieve the performance standards in the ROD through the area of attainment. The suggested language allows for a re-evaluation of a pump and treat system's performance standards and/or selected remedy if it is apparent that contaminant levels have ceased to decline. Further, CERCLA Section 121(d) establishes six conditions under which an ARAR may be waived. One of those conditions, technical impracticability, may be petitioned at any time.

Feasibility Study

Comment: In Section 2.2.3, the FS Report notes that all Farm Chemicals Area wells were more acidic than the background well and that this may have contributed to the elevated metals levels. The well highest in metals, MW-04, initially had a pH of 3.10. Concentrations of naturally occurring metals were fairly high (aluminum at 570 mg/l, calcium at 290 mg/l). The section does not say whether the low pH is site related. The effect of acidity on metals levels should be evaluated further before metals are considered a compound of concern. Also, one well is insufficient to develop a statistical determination of background concentrations. The ROD should leave the determination of whether metals are a contaminant to the pre design field efforts of Remedial Design.

EPA Response: The low pH at the Farm Chemicals Area must be related to the site as are other confirmed contaminants. A pH at this level is not naturally common for groundwater as determined in the data collected from the remedial investigation and subsequent studies. In addition, the low pH is associated with the highest concentrations of numerous metals, volatile organics, semi-volatile organics, and is associated with some of the highest levels of total pesticides. A low pH's ability to elevate the metal concentration in the groundwater is likely a function of its ability to dissolve metals from the rock matrices. EPA disagrees in this case that more than one well is needed to define background metals concentrations. The difference between background metals concentrations and most metals concentrations in the MW-04 sample is so extreme that it is inconceivable that the MW-04 sample represents background.

Comment: In Table 3-4, groundwater remediation levels based on North Carolina Water Quality Standards for Groundwater may be below the CRDL or CRQL for the Site. The remediation levels should not be less than the quantification limits and the CRQL should represent a lower limit for remediation.

EPA Response: EPA has identified the performance standards in Table 23 of this ROD's Decision Summary. These standards are based on risk based levels, CLP Required Quantitation Limits, CLP Required Detection Limit, CLP Estimated Quantitation Limit, State and Federal ARARs, and an EPA action level.

Comment: In Table 4-2, discharge to the POTW is rejected from further consideration at the Farm Chemicals/Twin Sites Areas but it is retained in the Proposed Plan alternatives.

EPA Response: EPA acknowledges an error exists in Table 4-2. The discharge option to the POTW should have been retained on Table 4-2 for the Farm Chemicals/Twin Sites Areas as it was included in the development and detailed analysis of alternatives in the Feasibility Study.

Comment: In Tables 4-2 and 4-3, the rationale for rejection of individual technologies is generally not clear or is absent. Ion exchange may be required to remove trace levels of specific metals following precipitation but this technology was rejected. Vertical barriers were not considered for Farm Chemicals/Twin Sites Areas and were rejected for the Fairway Six Area. While containment of the plume may not be possible, vertical barriers can be used to reduce the required extraction rates and should be considered in conjunction with groundwater extraction.

The FS apparently presumes that precipitation can remove all metals to whatever discharge levels are required and that activated carbon can do the same for all pesticides. Based on an evaluation of the Site pesticides, activated carbon should be effective for all the pesticides with the possible exception of dasanit. There is no technical confirmation of this in the FS Report however.

The evaluation of treatment technologies should be based on their ability to attain the likely effluent standards for the allowable discharge options. This would require that discharge limits be determined and compared to blended influent groundwater concentrations to evaluate the extent of treatment that would be required. As it is, there is no basis to say whether metals removal would be required and if so whether any of the five technologies are capable of achieving the required removal rates.

EPA Response: Ion exchange is not cost competitive to the physical methods considered. Vertical barriers were eliminated during screening of technologies due to EPA's goal of implementing a treatment technology to clean up the groundwater. The vertical barriers were not considered at the Fairway Six Area due to low groundwater gradients and depth to a confining layer.

Dasanit is an organophosphate pesticide which also has two active sulfur atoms in its chemical structure which could make it amenable to adsorb to activated carbon. This would have to be confirmed through the carbon supplier or through treatability studies.

Remedial action processes will likely require testing to determine optimum operating parameters for the contaminants of concern at OU3.

Comment: In Section 5.0, the given criteria, especially regarding alternatives that exceed ARARs are outdated and not appropriate. The NCP requires that groundwater alternatives be developed that have different restoration periods. The sentence following the bullet list is unclear.

EPA Response: EPA agrees that the criteria regarding alternatives which exceed ARARs is outdated. Alternatives were developed in accordance with the NCP and evaluated a number of alternatives which provided treatment, institutional controls, innovative technologies and the no-action alternative.

Comment: On page 5-4 of the FS Report, the description of air stripping says that organic contaminants "are transferred into a vapor phase and burned in an incinerator". The incinerator exhaust gases would then be "acid gas scrubbed" because of the chlorinated VOCs. The primary VOCs are non-chlorinated aromatics. Vapor phase carbon adsorption or a catalytic oxidizer would be potential alternatives to incineration for the control of air stripper emissions if concentrations at the nearest receptor exceeded allowable levels and/or the state loading level. The Proposed Plan doesn't mention incineration of the air stripper emissions. The method of off gas control for the air stripper should be determined during Remedial Design once a firm design basis is established.

EPA Response: EPA agrees that vapor phase GAC may be a potential alternative to incineration for control of air stripper emissions. However, EPA's evaluation of the cost for vapor phase GAC was much greater than thermal treatment. New information submitted to EPA which supports alternative air emissions control technologies may be considered by EPA and, as necessary, appropriate modifications to the remedy will be made in accordance with the NCP.

Comment: On page 5-5, the volume reduction for reverse osmosis (RO) of 100 is not realistic. Typical reject rates are 10 - 20 percent, depending on the quality required for the permeate. A reject rate of 20 percent (volume reduction of 5) would be more likely based on the anticipated low discharge rates for pesticides. RO systems are prone to fouling/plugging and typically require pretreatment, which is not discussed.

EPA Response: We agree that a volume reduction of 100 is not likely achievable. However, even at a volume reduction of 100 RO is not an economical alternative at a total present worth cost estimate of \$27,113,091.

Comment: On page 6-2 of the FS Report, the text states that there are "no... O&M costs for this alternative," but monitoring costs are included in Table B-1.

EPA Response: EPA agrees the text on page 6-2 of the FS Report is contradictory. The monitoring costs found on Table B-1 represent periodic monitoring required if hazardous substances, pollutants, or contaminants remain at the site, in accordance with CERCLA Section 121(c).

Comment: On page 6-4 of the FS Report, in the last paragraph, iron and nickel have apparently replaced antimony and copper as the metals of concern. Iron could present a fouling problem, but it is unclear why nickel is a concern.

EPA Response: Metals in solution can combine with organic compounds to form organic chelates which may interfere with GAC adsorption of contaminants. The author did not intend to omit any metals of concern from the discussion. Table 3-4, page 3-21 of the FS Report shows that the groundwater maximum for nickel exceeds the nickel MCL of 100 ug/l.

Comment: On page 6-7, the FS Report states that air stripper emissions must be incinerated because the organic loading of 150 pounds of VOCs per day is too high for vapor-phase carbon to be cost effective. No design basis is given to support this opinion. The loading is equivalent to a blended VOC concentration of 52 mg/l at the total flow rate of 240 gpm. This concentration is almost certainly incorrect because the extraction system will be located downgradient of the highest wells (approx. 100 mg/l of VOCs), concentration of all the wells will be blended prior to treatment and the concentrations will decrease with time. The ROD should allow the determination of any off gas controls for the air stripper to be left to Remedial Design.

EPA Response: This ROD's Decision Summary has selected thermal treatment as a means of treating the air stripper off-gas. These measures were included in the alternative evaluation because it was anticipated that air emission controls would be a necessary component of the remedy. It may be determined during design however, that such measures are not necessary.

Comment: On page 6-7, it is noted by the commentor that reinjection may not be the preferred discharge method if it significantly increases the amount of groundwater that must be extracted and if the discharge criteria are more stringent than for a surface water or the POTW.

EPA Response: For cost purposes both reinjection wells and infiltration trenches were utilized as the method for discharge. However, the text goes on to say that the Remedial Design phase will determine the exact system to use. This is reflected in this ROD's Decision Summary.

Comment: In Table 2-14 of the FS Report, it appears that the samples for wells GW-302 and GW-303 were reversed between the Round 1 and Round 2 sampling events.

EPA Response: The analytical data presented in Table 2-14 reflects the results copied from the RI Report (page 4-119). These results were also compared with the raw data sheets found in Appendix A of the RI Report (pages 199 and 204) and appear to be accurate.

Comment: On page 7-2 of the FS Report, EPA admits that "Contaminant concentrations are low but not within acceptable levels" for the Fairway Six Area. EPA allows disposal of old pesticides if they are used at the recommended application rates. Theoretically, the extracted groundwater could be used to irrigate the golf course without treatment if the resulting land-applied concentrations were within the allowable levels. This option should be allowed by the ROD once the blended pesticide concentrations are within the allowed application levels.

The discussion in the FS Report on Contaminant Fate and Transport (Section 2.3) did not adequately address the natural degradation of low level pesticides in groundwater. Degradation rates should be estimated from literature values for the contaminants of concern. This information should be used along with infiltration and contaminant velocity data to predict the period for natural restoration of the groundwater at the Fairway Six Area. The resulting time frame should be compared with Alternative 4 to better evaluate the acceptability of Alternative 2, Limited Action. This evaluation should consider that there are no current or anticipated receptors of groundwater at the golf course.

EPA Response: The conservative approach for the Fairway Six Area being developed for residential use was used throughout the FS. Natural degradation of the pesticides would not serve as an active response to the cleanup of OU3 in the earliest timeframe to restore the land and water to its beneficial use. In addition, a portion of the Fairway Six Area is owned by a developer. It is therefore very likely that a portion of the Area may become residential in the future.

D. Comments from Other Interested Parties

Comment: A local citizen, who is also a member and officer of MooreFORCE, Inc., raised a concern over the lack of testing for dioxins on the Site and the lack of "no good reason" for EPA's omission. The commentator further stated that dioxin contamination could not be cleaned up by thermal desorption (the suggested remedial action).

The commentator questioned apparent discrepancies regarding the quality of surface water in the area from that which had been read in the local newspapers covering "everything from high levels of mercury in the town lake to the closing of contaminated city wells."

The commentator requests that all clean-up activities be halted until thorough testing of ground/surface waters in the area of the Site be conducted for the chemicals already found at the sites, as well as dioxins. The commentator also requested that adequate research on possible water contamination is done.

EPA Response: In accordance with EPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", the RI/FS initially underwent a scoping process in which existing data were collected, summarized, and evaluated. Data needs for the remedial investigation were then determined based on an evaluation of existing data, knowledge of site operations and disposal practices. Dioxin was not identified in the 1987 scoping process as a contaminant to have been detected at the Site previously or one which was used in the pesticide formulation process.

This operable unit, OU3, a part of which is this responsiveness summary, addresses contaminated

groundwater and ecological concerns at three Areas of the Site: Farm Chemicals, Twin Sites, and Fairway Six. EPA assumes that the reference to the "suggested remedial action" relates to the September 1991 Record of Decision for OU1 and Amended Record of Decision for OU4. The September 1991 Record of Decision and Amended Record of Decision selected thermal desorption as the treatment technology to remediate contaminated soil. This document was signed by EPA's Regional Administrator and is a final decision.

EPA does not recall stating that surface water in the area was "clean" and regrets if EPA's statements were misinterpreted. Extensive surface water sampling conducted throughout the area indicates that contamination of surface water has occurred. However, the associated human health risks from exposure to the surface water contamination are within a risk range which EPA finds acceptable. EPA's information does not indicate "high" levels of mercury in the town lake. In fact, neither the 1991 Remedial Investigation Report nor the 1993 Environmental Assessment Report indicate any detection of mercury in the surface waters of Pages Lake. The commentor is correct in stating that contamination has been documented in some of the Town of Aberdeen municipal water supply wells and has resulted in the closing of at least 3 of those wells, but not as a result of OU3.

EPA will conduct dioxin sampling and analysis of all media at the Site. EPA, however, does not find it in the best interest of protection of the public and the environment to "stop all clean-up activities" pending the outcome of the sampling and analysis results. If dioxins are found, it is unlikely that the remedy will change. However, the remedy may be modified as appropriate, based on new information and in accordance with the National Contingency Plan.

Comment: The U.S. Fish and Wildlife Service (FWS) reiterated from previous correspondence that cleanup goals for Site soils should be re-evaluated as they relate to avian receptors. The FWS is seriously concerned that post-remediation monitoring of residual contamination's potential impacts to song birds and raptors will indicate that an actual hazard still exists to these organisms. Any mechanisms to isolate soils exceeding 1 ppm chlorinated pesticides is strongly recommended.

EPA Response: The objectives of this ROD are to address contaminated groundwater, sediment, surface water and ecological considerations. A Record of Decision for OU1, an Amended Record of Decision for OU4, and a subsequent Explanation of Significant Differences established performance standards to remediate contaminated soil at the Site. It is inappropriate in this decision document for OU3 to re-evaluate the soil performance standards for OU1 and OU4.

Of particular concern is the potential exposure of avian receptors to pesticides remaining in the soil following soil remediation. Soil remediation excavation goals are documented for Operable Units One and Four in the 1991 Record of Decision and Amended Record of Decision, and the December 1992 Explanation of Significant Differences. These RODs require that treated soil be replaced into the original excavated areas, backfilled to grade and revegetated with native grasses. Exposure of avian raptors to DDT at 11 ppm, the soil performance standard, results in hazard quotients of 1.7 and 6.3 for the robin and red-tailed hawk, respectively. The toxaphene remediation goal of 6 ppm resulted in a hazard quotient of 1.7 for the robin. Avian raptors utilizing an Area 100% is not likely and therefore hazard quotients exceeding one under this scenario are not considered further.

It is EPA's view that post-remediation monitoring of residual contamination's potential impacts to song birds and raptors will be minimal. The ecological risk assessment performed for the Site, was not based on actual field data, but rather was based on existing literature. The ecological risk assessment provided a conservative approach in which assumptions were not true of Site conditions. EPA therefore does not find that the risk assessment results warrant a re-evaluation of the soil performance standards. An ecological risk evaluation following soil and groundwater remediation will be based on actual field data. EPA finds it appropriate at this time to allow time for remediation of contaminated soil and groundwater, then, monitor and evaluate ecological risks at the Site.

Comment: The League of Women Voters of Moore County agrees with the choice of the preferred alternatives and encourages moving forward with the clean up.

EPA Response: EPA recognizes the League of Women Voters' support in wanting the Site to be cleaned up completely and effectively.

Comment: The League of Women Voters urged EPA to seriously consider changing the Information Repository location from the Aberdeen Town Hall to Page Memorial Library in Aberdeen where it would be more accessible to the public.

EPA Response: EPA investigated the possibility of moving the Information Repository to the Page Memorial Library and found that Page Memorial Library is open on a limited scheduled. Therefore, the Aberdeen Town Hall which is open from 8:00 a.m. to 5:00 p.m. five days a week, continues to be the most suitable location for the Information Repository.

Comment: The firm of Hunton and Williams requested a 30-day extension of the public comment period to July 10, 1993.

EPA Response: EPA granted this extension.

Comment: Town of Aberdeen officials are disturbed by the fact that no formal effort is underway to ascertain the source of contamination of three of its water supply settlement of the Site account for the loss of these wells and provide for their replacement. They request that no settlements be finalized until the source of the contamination is determined. Assistance is requested in identifying the source or sources of contamination. Finally, the Town is seeking technical and financial assistance in mitigating the contaminated well sites to the extent necessary to utilize the sites as a safe water supply source.

EPA Response: As noted in an earlier EPA response regarding this same issue, the State of North Carolina will be investigating further the potential sources of contamination in the Town of Aberdeen water supply wells. As this issue relates to OU3, an EPA-financed USGS study evaluated whether groundwater could migrate beneath Aberdeen Creek and contaminate town water supply wells east of Pages Lake and Aberdeen Creek. The study results determined that Aberdeen Creek acts as a point of discharge for subsurface water. Therefore, any groundwater contamination as a result of the Farm Chemicals/Twin Sites Areas is being discharged to Pages Lake and Aberdeen Creek and could not have contaminated Aberdeen municipal water supply wells.

Under OU3, the Agency cannot at this time provide for either the replacement of loss town wells or assure the Town of Aberdeen that "no settlements" will be finalized until the source of contamination is identified. To the best of EPA's knowledge, none of the contamination found at the Farm Chemicals, Twin Sites, or Fairway Six Areas has resulted in contamination of the Aberdeen Town Wells.

Comment: There is an extremely high cost associated with implementing the chosen alternatives for remediation of soil and groundwater at OU3. The danger rests upon the idea of future residential use, where the dwelling would have its own well rather than to be tied to a municipal water system. Rather than to have these tremendous expenses, it may be appropriate to enact legislation to prohibit these areas from being used for residential purposes. Or, it might be even possible to limit the land use for residential purposes unless served by municipal water systems.

EPA Response: The alternatives chosen provide the best balance of trade-offs with respect to the nine criteria which EPA uses to evaluate alternatives. EPA believes the preferred alternative will satisfy the statutory requirements of CERCLA, which provides that the selected alternative be protective of human health and the environment, comply with ARARs, be cost effective, and utilize permanent solutions and treatments to the maximum extent practicable.

In addition, the NCP states that the use of institutional controls shall not substitute for active response measures (e.g. treatment and/or contaminant of source material, restoration of groundwater to their beneficial uses) as the sole remedy unless such active measures are determined not to be practicable, based on the balancing of trade-offs among alternatives that is conducted during the selection of the remedy.

APPENDIX B TO THE RECORD OF DECISION

STATE LETTER OF CONCURRENCE
FOR
ABERDEEN PESTICIDE DUMPS SITE
OPERABLE UNIT THREE

ABERDEEN, MOORE COUNTY, NORTH CAROLINA

SEPTEMBER 1993

State of North Carolina
Department of Environment,
Health and Natural Resources
Division of Solid Waste Management

James B. Hunt, Jr., Governor
Jonathan B. Howes, Secretary

September 14, 1993

Ms. Kay Crane
Remedial Project Manager
US EPA Region IV
345 Courtland Street, NE
Atlanta, GA 30365

RE: State Concurrence with the Draft Record of Decision for the Aberdeen
Pesticide Dumps Site Located in Aberdeen, Moore County, NC NCD 980 843 346

Dear Ms. Crane:

The State of North Carolina has reviewed the Draft Record of Decision (ROD) for the Aberdeen Pesticide Dumps Site and concurs with the selected remedy, subject to the following conditions.

1. Based on revised documentation, the State understands that preliminary remedial design activities shall include sampling of existing monitoring wells and analysis for dioxin and dibenzofuran contaminants during Operable Unit #3. If dioxins or dibenzofurans are found to be present in groundwater, the resulting information may require:
 - A. minimization of the effects of phenolic compounds, which could form dioxins or dibenzofurans, by initiating a granular activated carbon adsorption treatment of the extracted groundwater prior to air stripping,
 - B. a treatability study to evaluate the potential of dioxin formation from an off-gas incineration process,
 - C. modification to the emission control system resulting from the air stripper, and
 - D. as appropriate, initiate proper handling, transportation and disposal.
2. If dioxins/dibenzofurans are found in the groundwater, risk values and associated remedial action objectives for groundwater must be recalculated and submitted for review.
3. Regardless of whether dioxins/dibenzofurans are found in the groundwater or not, additional soil sampling for these compounds will also be required to define source areas or to verify that areas with the highest pesticide contamination in the soils do not contain dioxins/dibenzofurans.

4. State concurrence on this Draft ROD and the selected remedy for the site is based solely on the information contained in the draft ROD dated July 26, 1993. Should the State receive new or additional information which significantly affects the conclusions or remedy selection contained in the Draft ROD, it may modify or withdraw this concurrence with written notice to EPA Region IV.
5. State concurrence on this ROD in no way binds the State to concur in future decisions or commits the State to participate, financially or otherwise, in the clean up of the site. The State reserves the right to review, comment, and make independent assessment of all future work relating to this site.
6. The remedial objectives for the Aberdeen site are noted on pages 73 and 74 of the Draft ROD dated July 26, 1993. The remedial action objectives for the various media at the subject site do not meet the North Carolina 10[-6] risk level requirements. Therefore, the State will implement the required deed recordation/restrictions to document the presence of residual contamination and possible limit the future use of the property as specified in NCGS 130A-310.8

The State of North Carolina appreciates the opportunity to comment on the Draft Record of Decision for the subject site, and we look forward to working with EPA on the final remedy.

Sincerely,

Jack Butler, PE
Environmental Engineering Supervisor
Superfund Section

cc: Randy McElveen, NC Superfund Section